ADOPTION OF GREEN BUILDINGS IN PAKISTAN

To achieve Pakistan's Nationally Determined Contribution

2024.09

Abstract

This report is a draft of the evaluation system and criteria development for the establishment of a green building certification system in Pakistan and is intended to facilitate the review with partner organizations. First, we summarize the current status, challenges, and implications of green building in Pakistan. Then, we examined the challenges and strategies to achieve energy efficiency in buildings considering the diversity of local climate zones, and proposed a green building certification system and detailed criteria for Pakistan.

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I. Executive Summary

An NDC report indicates that Pakistan has set an ambitious conditional target to reduce the country's projected total emissions by 50% by 2030. This reduction is to be achieved through a combination of 15% reduction in emissions from Pakistan's own resources and 35% reduction in emissions from the energy transition. The latter will require international financial assistance of approximately USD 101 billion. To achieve this target, Pakistan has established goals to switch 60% of its energy mix to renewables and 30% of vehicles on the road to electric vehicles. It also plans to introduce a complete ban on coal imports. However, there are still several challenges to overcome, including a lack of local expertise and skills in green buildings and the public's lack of awareness of the need for green buildings.

This study aims to enhance public awareness of green buildings and facilitate a low-carbon transition in Pakistan through the development of a green building rating system and detailed criteria.

To this end, we conducted a comparative analysis of green building policies and certification schemes in many Asia-Pacific countries to identify best practices applicable to Pakistan's context. The findings from this analysis formed the basis for establishing a green building assessment system for Pakistan. Based on this, we conducted a SWOT analysis and developed basic measures for green building applications in Pakistan.

Second, we conducted a review of prior local studies and materials from workshops, among others, with the objective of gaining insight into the country's current status. This included an analysis of policies, economics, and market conditions that may influence local green building practices and existing buildings. At the same time, we conducted an in-depth examination of the characteristics of the local climate and the local architectural practices with the aim of facilitating the development of a green building code tailored to Pakistan's context. The results of these local environmental surveys provided the basis for establishing a green building rating system for Pakistan. Based on these results, we conducted a SWOT analysis and developed a strategy for green building applications in the local context.

Third, we used the findings from the aforementioned analyses to develop a viable green building assessment model for Pakistan and outlined the implementation of the rating system. Finally, we proposed a draft evaluation mechanism and detailed criteria for green building evaluation. The development of a green building rating system and detailed

criteria will facilitate Pakistan's efforts to transition to a low-carbon economy and achieve the United Nations' Sustainable Development Goals (SDGs).

The findings of this study will provide Pakistan with insights on how to develop policies to promote green building practices, which will enhance the resilience of the construction sector and lay the foundation for the decarbonization of the economy.

II. Overview

1. Purpose and Rationale of the Project

■ Purpose and Background

- **Project Title**: Adoption of green building in Pakistan to achieve Pakistan's nationally determined contribution
- **Country**: Pakistan

The need for a response to the ever-accelerating climate crisis resulting from climate change and the rapid urbanization of developing countries has led to increasing interest in and expectations for building energy efficiency, as well as green building standards and regulations. Pakistan is facing challenges to introduce green buildings due to the lack of awareness and limited funding, despite the country's efforts to envision carbon emission reduction as a national goal. In Pakistan, several studies have already been conducted with the support of the EU and SWITCH-Asia[1] to develop a green building code. However, the absence of green building standards and regulations means that the sustainability aspects are still not considered in urban development projects pursued nationwide.

The Ministry of Climate Change of Pakistan has submitted a Technical Assistance Response Plan to the United Nations Climate Technology Centre and Network (UN CTCN). In response, the UN CTCN has requested the South Korean government (Korea Institute of Civil Engineering and Building Technology, KICT) to consider a partnership program with Pakistan. The KICT has executed this study as part of the partnership program, entitled "Adoption of Green Building in Pakistan to Achieve Pakistan's Nationally Determined Contribution."

The KICT and Korea Research Institute of Eco-Environmental Architecture (KRIEA) has developed a rating system based on a local fact-finding survey and international case

[1] *SWITCH-Asia is a program funded by the European Union (EU). Launched in 2007, it supports Asian, Middle Eastern, and Pacific countries in their transition to a low-carbon, resource-efficient, and circular economy and promotes sustainable production and consumption, facilitating the creation of sustainable supply chains connecting these regions with Europe.*

studies to assist Pakistan in achieving carbon neutrality, responding to climate change, and promoting green building practices in the medium to long term.

■ Rationale

Many developing countries are working to reduce carbon emissions by promoting low-carbon, zero-energy architecture and green buildings. However, they still face significant challenges in implementing and adopting these practices, while they are seriously affected by the exposure to rapid climate change. In this context, it is crucial to develop effective and feasible green building evaluation criteria and a certification model.

Figure 1. Project background

In Pakistan, international green building certification systems such as Leadership in Energy and Environmental Design (LEED) are used in practice. However, differences in perceptions of people who apply the certification systems to practices and the inherent limitations of LEED, which was developed primarily based on the climate and environmental conditions in North America, that are not in line with the various climate and environmental conditions of Pakistan[1] highlight the urgent need to develop a new certification system and criteria for green buildings. To this end, it is essential to explore the best practices of Asia-Pacific countries that have similar climatic conditions to Pakistan and develop an actionable green building certification model and evaluation criteria tailored to Pakistan. It is also necessary to identify the current laws and policies for green buildings in Pakistan and to establish a rating system that reflects the local market conditions and circumstances. In other words, the new green building certification system in Pakistan should have flexibility to respond to the country's economic and environmental contexts. This study will also contribute to the advancement of sustainable building practices and the achievement of the SDGs in Pakistan and numerous other developing countries.

2. Scope and Objectives of the Project and Key Tasks

■ Scope of the Project

The scope of this project is to conduct a comprehensive literature review and local fact-finding survey on green building practices in Pakistan, to develop an effective evaluation model and operational system, to analyze overseas trends and data, to develop an evaluation model and criteria, and to identify methods and mechanisms to apply the model to practice.

■ Objectives and Key Tasks

This study aims to contribute to Pakistan's transition to a low-carbon economy and achieve the UN SDGs by establishing a green building rating system, including evaluations of components thereof. It will also raise public awareness of sustainable architecture in Pakistan and facilitate the low-carbon transition. Figure 2 shows the key tasks performed in this study.

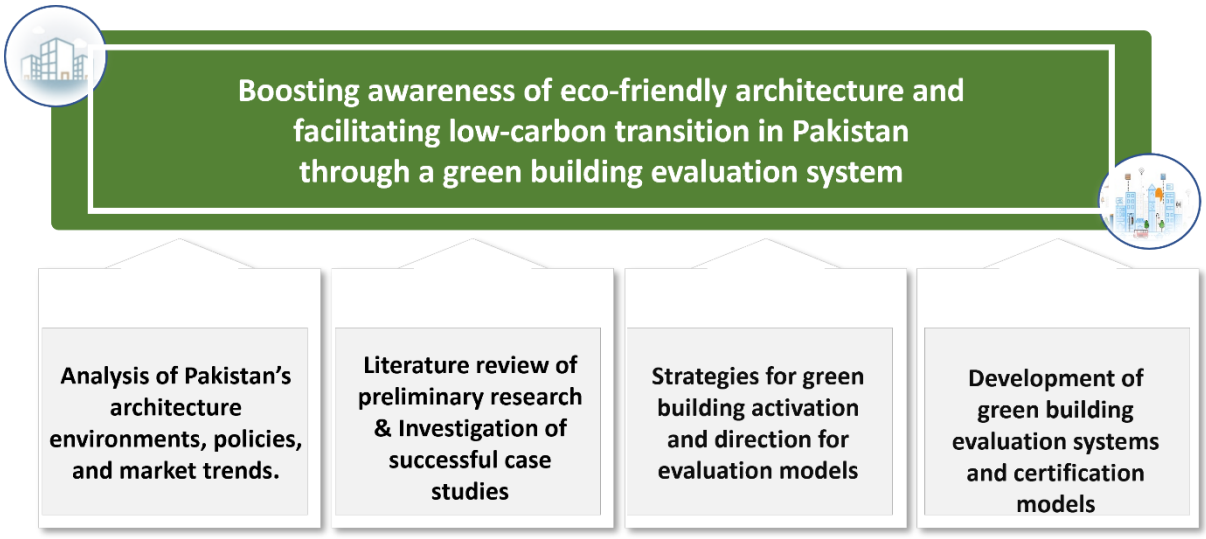

Figure 2. Major implementation tasks for this research

- Identify best practices applicable to developing countries by identifying successful cases of green building technology, policy, institutions, and support systems in Asia-Pacific.
- Conduct surveys on local building conditions, construction industries, building energy supply and demand, green building and energy plans, and policies and regulations in place or planned in developing countries to understand local contexts and issues.
- Analyze the results of these surveys to identify implications and improvement plans for the promotion of green building practices in developing countries.
- Develop a green building evaluation mechanism and detailed criteria.

3. Project Structure and Progress

■ Project Structure

The KICT spearheaded the development of the evaluation model and certification system for the Pakistani Green Building Code. Green Growth Consulting (GGC), a Pakistani expert group, prepared an expert report on the status of green building and architecture in Pakistan. The KRIEA, in collaboration with the two organizations, analyzed the status of

Pakistan and identified gaps in current policies and delivered the findings to GGC in six review opinions.

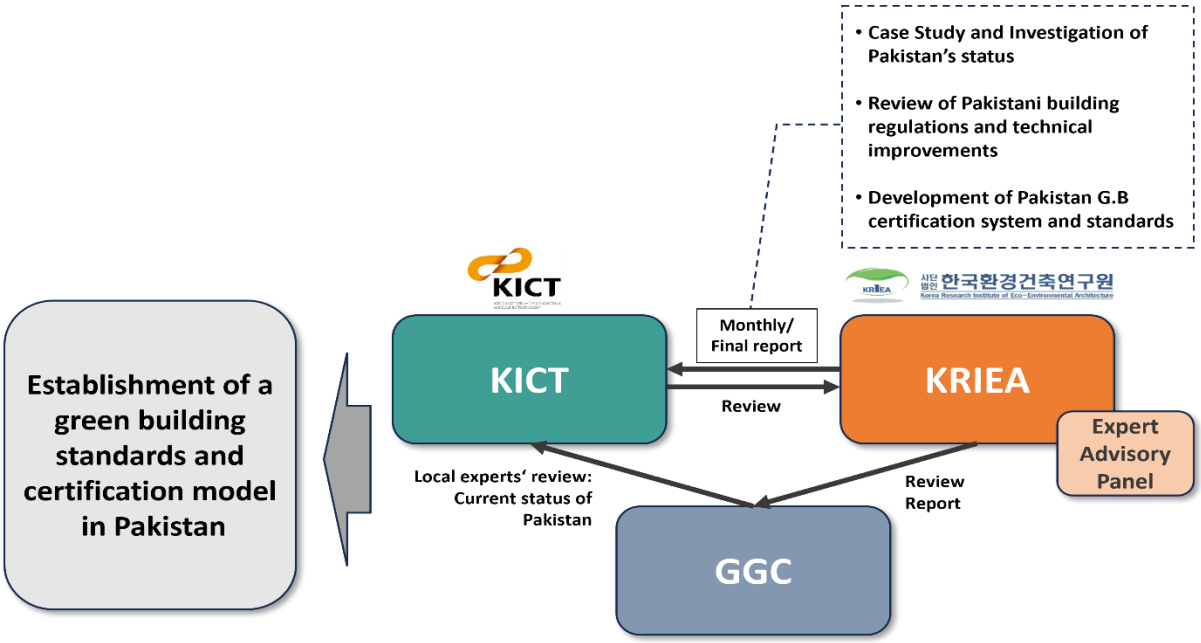

Figure 3. Strategic research development system with defined roles for establishing green building standards and a certification model in Pakistan

■ Project Progress

The international collaborative research framework established four stages of detailed tasks with the objective of developing actionable green building standards and an evaluation model (Figure 4). Following the project initiation stage, we conducted research on successful cases of green building certification systems and schemes in the Asia-Pacific region and identified cases and policies applicable to Pakistan's context. In the third stage, we analyzed green building technologies, policies, and markets in Pakistan and developed a strategy. In the final stage, we set the direction for the development of green building standards applicable to Pakistan and proposed a certification model system.

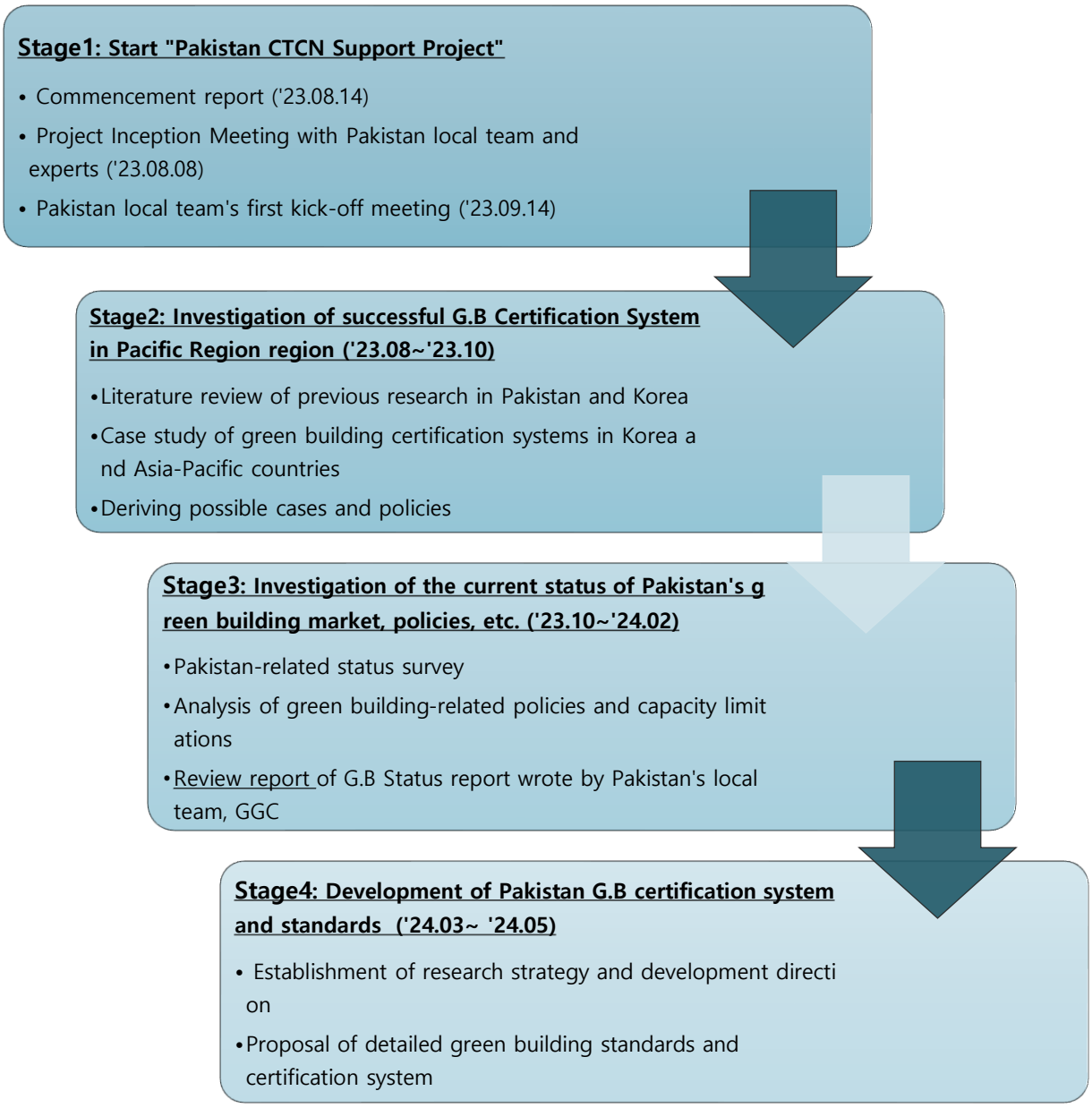

Figure 4. Research process for developing a green building certification model and proposing standards for Pakistan

4. Expected Outcomes

The World Green Building Council (WGBC) conducted case studies in Australia, India, South Africa, and the United States, among other countries. The study categorized the benefits of green building into three categories: environmental, economic, and social [2].

- Environmental
  - Reduce greenhouse gas emissions from the building sector by up to 62%.

- 40-50% energy savings and 20-30% water savings compared to conventional buildings.

- Economic
  - Lower utility bills for residents.
  - GB industry's contribution to GDP and full-time jobs.
  - 7% higher property value compared to conventional buildings.

- Social
- Well-ventilated offices have been shown to contribute to increased cognitive abilities (brain function) and improved sleep quality.

- Improved indoor environmental quality (lower CO2 and pollutant concentrations, better ventilation) can lead to productivity gains of up to 8%.

This study will also assist in developing a government-led green building rating system and serve as a driving force for building a green building industry ecosystem in developing countries. The expected outcomes of this study are as follows:

- Green building awareness: Raise awareness of the importance of green building, the market ecosystem, benefits and constructability in both the public and private sectors.

- Best practices and export markets: Provide best practices for the green building technology market in developing countries and facilitate overseas market penetration of relevant policies and technologies.

- Local workforce training: Use the results of the study to train local professionals, develop guidelines, and address negative perceptions of green building.

- Policy resource: Use as a valid policy reference for planning and implementing green building policies.

III. Investigation of International Best Practices for Green Buildings (with a Particular Focus on the Asia-Pacific Region)

1. Analysis of the status of Green Building System in Korea

- Paragraph 1. Overview of G-SEED

The「Green Standards for Energy and Environmental Design」generally refers to a system that evaluates and certifies the environmental friendliness of a building in order to reduce environmental burdens such as use of energy and resources and pollutant emissions that may occur throughout the entire building process of the material production stage, design, construction, maintenance and disposal, and to create a pleasant environment.

At present, the Korea's Green Standards for Energy and Environmental Design (hereinafter G-SEED), which was introduced in 2002 for apartment houses, quantitatively evaluates the eco-friendliness of newly constructed buildings, including small houses and apartment houses as residential buildings, and commercial buildings, residential complexes, schools, retail facilities, accommodation facilities, and other buildings as non-residential buildings. It also evaluates existing buildings, including apartment houses and commercial buildings. In 2016, the G-SEED was completely reorganized and is divided into new buildings (residential, non-residential, single-family houses) and existing buildings (residential, non-residential, green remodeling).

The G-SEED is Korea's only evaluation system that comprehensively evaluates the eco-friendliness of buildings. The government and local governments require public buildings to obtain certification, and provide incentives by developing support policies for green buildings that have obtained certification.

The policy direction for green buildings aims to minimize damage to the environment throughout the life cycle from design, construction, operation and maintenance to disposal for the purpose of saving energy, saving and recycling resources, preserving the natural environment, and creating a pleasant indoor environment for all buildings in the future

- Paragraph 2. Operating system of G-SEED

The G-SEED is being operated by the Korea Institute of Construction Technology (KICT) under the overall management mandate from the Ministry of Land, Infrastructure and Transport and the Ministry of Environment, and the green building certification assessment is being carried out by 9 certification agencies, including the Korea Environmental Industry and Technology Institute. The Management Committee and Certification Review Committee are organized in relation to management and certification. The Management Committee is in charge of reviewing the establishment and revision of standards and making decisions on system improvement, while the Certification Review Committee conducts review and final evaluation decisions on the certification review reports evaluated by the certification agencies.

The role of the management agency is to carry out tasks such as operation of the certification management system, review of the results of the certification agency's examination, promotion of the certification system, education, consulting, research and development, and improvement and activation of the certification system.

The G-SEED institutions consist of five public institutions including the Korea Environmental Industry and Technology Institute and four private organizations including CreBizQM, and each certification agency is required to have at least five examiners. To apply for certification, the building owner (applicant) must write a self-evaluation report and submit it to the certification agency, and the certification agency must verify the evaluation report through document review and on-site inspection and issue a certificate.

- Paragraph 3. Specialized Fields of G-SEED

The G-SEED conducts an evaluation of the overall environment from the external environment to the internal environment of the building, as well as the entire process from the design stage to the post-construction stage. Thus, specialized fields are organized for each certification item and evaluated.

In the early stages of implementation in 2002, the evaluation was divided into four fields: land use and transportation, energy and resources, ecological environment, and indoor environment. However, as the certification fields were expanded to commercial buildings, school facilities, etc. other than apartment houses in 2006, the specialized fields were also expanded to 10 fields, including land use, transportation, and energy. And then, through

the reorganization of the certification system, evaluations are currently conducted in seven fields, from land use and transportation to indoor environment, and in the case of apartment houses, the housing performance field is evaluated.

[Table] Evaluation details for each specialized field of G-SEED

Specialized field	Evaluation details
Land use and transportation	Evaluate by considering the relationship with the external environment in terms of considering or restoring the ecological function of the land as much as possible
Energy and environmental pollution	Evaluate architectural measures and system-related measures for energy consumed for building operation
Materials and resources	Evaluate the use and input ratio of low-carbon materials and recycled materials that reduce environmental pollution and impacts based on the impact of materials in the entire life cycle of a building
Water circulation management	Evaluate methods for managing and using rainwater for promoting water conservation and efficient water circulation
Maintenance	Evaluate architectural methods that achieve minimization and maximization of environmental impact through appropriate maintenance systems
Ecological environment	Evaluate in terms of diversifying the composition of biodiversity within the habitat by minimizing direct impact on biodiversity during the development process
Indoor environment	Evaluate the thermal, sound, light, and air environments by reviewing the parts to minimize the harm to occupants and neighbors in terms of health and welfare
Housing performance	Evaluate the performance of the building, such as the residential, living environment, durability, and variability of the house
Innovative design	Evaluate original/creative ideas through innovative green building design of buildings

The weighting for each specialized field is applied differently depending on the difficulty and importance of each field, and is also applied differently depending on new or existing buildings, residential or non-residential.

[Table] Weighting for each specialized field of G-SEED (2016 version)

Classification		Land use and transportation	Energy and environmental pollution	Materials and resource	Water circulation management	Maintenance	Ecological environment	Indoor environment
New	Residential	10%	25%	18%	10%	7%	10%	20%
	Single-family house	15%	25%	15%	10%	5%	10%	20%
	Non-residential	10%	30%	15%	10%	7%	10%	18%
Existing	Residential	10%	27%	15%	10%	15%	10%	13%
	Non-residential	10%	25%	15%	10%	15%	10%	15%
Green remodeling	Residential	-	60%	10%	10%	10%	-	10%
	Non-residential	-	60%	10%	10%	10%	-	10%

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- Paragraph 4. History of G-SEED

The development of G-SEED can be divided into three stages from 1999 to the present.

□ Introduction review stage: Research-centered

ㅇ Based on the 'Study on the Introduction of the Building Environmental Performance Certification System' of the Ministry of Environment in 1999, G-SEED began as a pilot certification method for eco-friendly buildings by integrating the 'Pilot Certification for Excellent Residential Environment Housing' of the Ministry of Land, Infrastructure and Transport and the'Pilot Certification for Green Building' of the Ministry of Environment in 2000, and the institutionalization plan for the 'Eco-friendly Building Certification System' was reviewed in 2001.

□ Introduction stage: Implementation of certification standards and preparation of detailed guidelines

ㅇ And then, the 'Detailed Guidelines for the Eco-Friendly Building Certification System' were established in 2002, and the certification system was first carried out based on apartment houses, and the target buildings were expanded to apartment houses (2002) → commercial buildings and complex buildings (2003) → school facilities (2005) → sales and accommodation facilities (2006).

ㅇ The initial certification levels were divided into two: Best and Excellent, and started with four certification agencies, and along with the expansion of certification to school facilities, the Korea Institute for Educational and Environmental Research was additionally designated in 2006

□ Settlement stage: Revision of certification system and expansion of buildings subject to certification

ㅇ In 2012, the 'Green Buildings Construction Support Act' was enacted to establish a legal basis for eco-friendly buildings, and the Korea Institute of Construction Technology (KICT) was designated as the management agency for smooth operation of the system, and six organizations including the Korea Infrastructure Safety and Technology Corporation were designated as additional certification agencies.

○ In 2013, the housing performance rating system, which is a certification system similar to the eco-friendly building certification system, was integrated and branded as 'G-SEED', and the reorganization of the specialized fields and rating system was carried out at the same time.

○ In 2016, the classification and criteria system were reorganized by unifying the existing classification by building use and separate certification items, and the naming G-SEED 2016 was established.

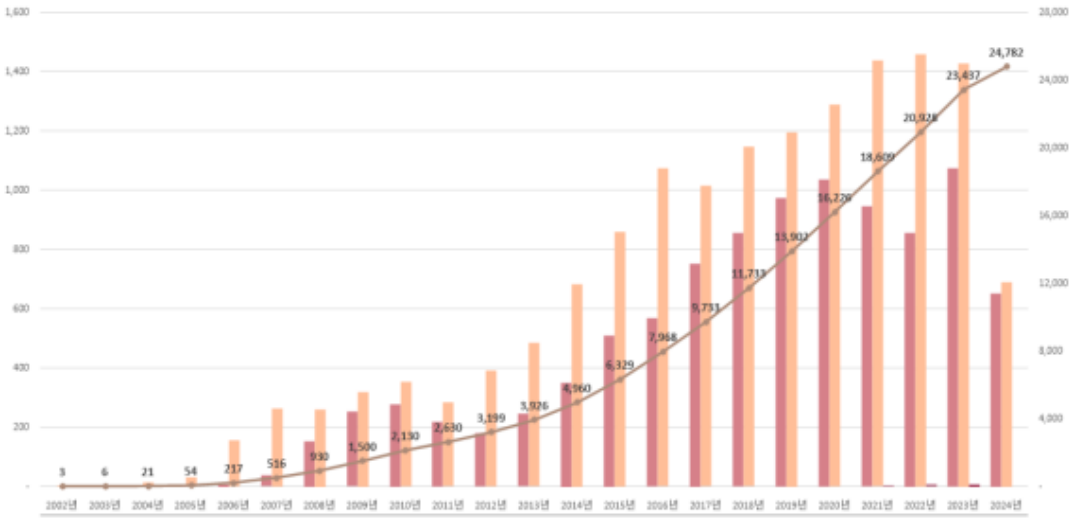
○ And then, based on G-SEED 2016, detailed criteria were revised in 2018, 2019, 2020, 2021, and 2023, and G-SEED 2016-7 version was operated in 2023

○ Also, beyond the application of G-SEED to the domestic market, standards were established for Vietnam in 2016 and Kenya in 2020, enabling acquisition of G-SEED for overseas ODA projects

○ In order to link green building for diplomatic offices managed by the Ministry of Foreign Affairs, such as overseas embassies and consulates, with the use of domestic technology and products, a version of G-SEED for diplomatic office was established and operated

- Paragraph 5. Examples - Best Practice of G-SEED certified buildings

□ Currently, there are over 24,000 G-SEED certified buildings in Korea, as shown in the figure below. Since 2006, the number of G-SEED certified buildings has been continuously increasing, and is expected to steadily increase in the future. This chapter covers examples of buildings that have recently obtained G-SEED certification with excellent levels.



(1) Private rental housing for urban development project in Yonghyeon Hanik Block 1

□'Private rental housing for urban development project in Yonghyeon Hanik Block 1' is an example building that has recently received the highest level of G-SEED, 'Best (Green Level 1)' in July 2024, and is located in Michuhol-gu, Incheon Metropolitan City.

□ This is a project to design approximately 13,000 households of private rental housing on a site area of approximately 1.54 million (㎡), which is a small new city that contains self-sufficient functions with commercial, residential, and business complex sites.

□ Mainly four blocks form one city, creating a future-oriented residential complex that can be organically connected to each other through the Green Network, an economic complex for creating sustainable jobs, and a self-sufficient future city that combines housing, medical care, and education together

[Figure] Private rental housing for urban development project in Yonghyeon Hanik Block 1 (Green Level 1)

(2) Kunsan National University College of Engineering Integrated Education Center BTL

□ The'Kunsan National University College of Engineering Integrated Education Center BTL'building located in Daehak-ro, Gunsan-si, Jeollabuk-do has recently obtained an 'Excellent (Green Level 2)' with 71.04 points out of 100

□ This project, a G-SEED case certified by the Korea Real Estate Board, has implemented an eco-friendly building by applying various design techniques, and it is known that the power supply through renewable energy such as solar power and geothermal energy amounts to approximately 39.13%.

[Figure] Kunsan National University College of Engineering Integrated

Education Center BTL (Green Level 2)

(3) Hydrogen Energy Advanced Research Building

□ The 'Hydrogen Energy Advanced Research Building Construction Project Design Service' is an education and research facility of the Korea Institute of Energy Technology located in Yuseong-gu, Daejeon, with 1 underground floor and 7 above-ground floors. As a G-SEED certified building certified by the Korea Green Building Council (KGBC), this building has obtained'Excellent (Green Level 2)'

□ The Korea Institute of Energy Technology established this research building to research hydrogen, a future eco-friendly energy source, and to create a technology development research institute that can develop infinitely. Realizing the value of this research building through three goals: 1) harmony with the surrounding environment, 2) establishment of research infrastructure, and 3) future-oriented experimental environment, this project strives to make the hydrogen industry the center of national innovation and growth.

[Figure] Hydrogen Energy Advanced Research Building (Green Level 2)

(4) Construction of Incheon Geomdan Police Station

□ The 'Incheon Geomdan Police Station Construction Site' located in Majon-dong, Seo-gu, Incheon received G-SEED certification from the Korea Research Institute of Eco-Environmental Architecture, obtaining 'Excellent (Green Level 2)'

□ In the western part of Incheon Metropolitan City, large-scale apartment complexes are actively being built in Geomdan New Town, and large-scale development projects such as Cheongna International City are underway, leading to active support for expansion of police personnel and construction of Geomdan Police Station to stabilize local security.

[Figure] Incheon Geomdan Police Station (Green Level 2)

2. Analysis of the status of Green Building System in other countries

This study aims to provide a foundation for the development of a rating system and detailed criteria for green building. In this chapter, we analyze the green building policies and certification/rating systems of Asia-Pacific countries in the vicinity of Pakistan and identify best practices applicable to the development of a rating system for Pakistan.

Figure 5. Case study countries: 7 ASEAN countries and India

Table 1 provides an overview of the green building codes, related energy standards, and rating tools developed in the aforementioned eight Asia-Pacific countries. These countries have their own mandatory or voluntary guidelines and rating tools for public and private buildings.

Country	Green Building Codes / Related Codes including Energy Standards	Rating Tools
Brunei Darussalam[3]	• PBD 12: 2017 Building Guidelines and Requirements • EEC Building Guidelines for Non-Residential Buildings – 2015 (Mandatory for public buildings)	• Green Unified Seal (BAGUS) (Voluntary)
Thailand[3]	• Ministerial Regulation for Energy Saving Building Design BE 2552 (Mandatory for public buildings) • Energy Conservation Promotion Act BE 2550 - 2007	• TEEAM (Thailand Energy and Environmental Assessment Methods) (Voluntary) • TREES (Thailand Energy & Environmental Sustainability Assessment) (Voluntary)
Singapore[3]	• Code for Environmental Sustainability of Buildings - SS530:2014 - SS531-1:2006	• GreenMark - Mandatory of BCA (Building & Construction Authority) Green Mark certification

	- SS CP 38 - SS CP 43 - Code of Envelope	- Mandatory & Required to achieve various - For all new and major renovations (over 200 m2 certification levels)
Indonesia[3]	• Bandung Green Building Code (Mandatory) • Jakarta Green Building Code (Mandatory for large buildings (e.g. Bandung, Jakarta: buildings with a total area between 10000-50000m2)) • Energy standard: (Mandatory) - SNI 03-6389-2011 - SNI 03-6390-2011 - SNI 03-6197-2011 - SNI 03-6196-2011 - Energy Efficiency Guidelines for Building Design (Unknown for Mandatory)	• GREENSHIP (Voluntary)
Malaysia[3]	(Mandatory status unknown) • PH JKR, • GreenPASS, • Green RE • Energy standard: - MS 1525: 2014 (Voluntary) - MS ISO 50001 (Mandatory)	• Green Building Index(GBI) (Voluntary) • Malaysian Carbon Reduction and Environment Sustainability Tool (MyCREST)
Philippines[3]	• Guidelines for Energy Energy Conserving Design of Buildings – 2008 (Mandatory) • Philippines Green Building Code – 2015 (Mandatory)	• Building for Ecologically Responsive Design Excellence (BERDE) (Voluntary)
Vietnam[3]	• QCVN 09: 2013/ BXD (Mandatory)	• LOTUS (Voluntary)
India	Energy Conservation Building Code (ECBC) (Partially Mandatory)	• GRIHA (Green Rating for Integrated Habitat Assessment) (Mandatory for public buildings • IGBC (Indian Green Building Council) provides rating systems for different building types (Voluntary)

Table 1. National green building codes, related energy codes and rating tools and incentives

Table 2 provides a comparative overview of the evaluation and rating systems of the eight countries. The key evaluation items include building envelope, air conditioning systems, natural and artificial lighting, and renewable energy.

Country	Energy in Green Building Assessment Tool Efficiency Related Categories	Country	Energy in Green Building Assessment Tool Efficiency Related Categories
Brunei Darussalam	• Building envelope • Air conditioning systems • Building envelope - design/thermal parameters • Natural ventilation (for parking lots) • Artificial lighting • Ventilation in the parking lot • Ventilation in common areas • Elevators and escalators • Energy-efficient practices and features	**Thailand (TREES)**	• Minimum energy efficiency • Energy Efficiency • Renewable energy • Refrigerants in air conditioning systems that do not destroy the ozone layer
Singapore (Green Mark)	• Building envelope – Envelope Thermal Transfer Value (ETTV) • Air conditioning systems • Building envelope - design/thermal parameters • Natural Ventilation/Mechanical Ventilation • Natural lighting • Artificial lighting • Ventilation in the parking lot • Ventilation in common areas • Elevators and escalators • Energy-efficient practices and features • Renewable energy	**Indonesia (GREENSHIP)**	• Electricity submetering • OTTV Calculation • Energy Efficiency Measures • Natural lighting • Ventilation • Climate change impacts • On-site renewable energy (bonus)
Malaysia (GBI)	• Minimum Energy Efficiency (EE) performance • Illuminated zones • Electricity submetering • Renewable energy • Advanced EE performance • Improved commissioning • Post-occupancy commissioning • EE Verification • Sustainable maintenance	**Philippines (BERDE)**	• Detailed metering of energy • Energy-efficient lighting • Natural ventilation • On-site renewable energy generation • Improved energy efficiency • Energy-efficient building envelope
Vietnam (LOTUS)	• Passive Design • Total building energy • Building envelope • Natural ventilation and air conditioning	**India (GRIHA)**	• Sustainable Site & Planning • Energy Efficiency & Renewable • Energy • Water Efficiency

	• Artificial lighting Energy monitoring and management		• Material & Resources • Health & Well-being • Solid Waste Management

Table 2. Composition of the energy efficiency categories in the G.B. assessment tools of ASEAN countries

Table 3 lists the economic incentives offered by these countries to promote green building practices. These incentives include tax exemptions, low-interest loans, and funding programs for specific energy efficiency and renewable energy projects.

Country	Incentives program	Description
Brunei [3]	Feed-in Electricity Scheme	Low-cost loans to consumers to fund solar panel installation
Thailand [3]	Energy Efficiency Revolving Fund (EERF)	Fund loans to local bank at 0% interest rate with 7 years final maturity
Singapore [3]	Building Retrofit Energy Efficiency Financing (BREEF) Scheme	Financing program which provides credit facilities to carry out energy efficiency retrofits of existing commercial buildings
	BCA Green Mark Incentive Scheme for Exiting Buildings (GMIS-EB)	Funding program to encourage developers and building owner of existing building for its energy efficiency
	BCA Green Mark Incentive Scheme – Design Prototype (GMIS-DP)	Funding for the engagement of Environmentally Sustainable Design (ESD) consultants to conduct collaborative design workshops and assist in simulation studies
	BCA Green Mark Incentive Scheme for Existing Building and Premises (GMIS-EPB)	Cash incentive op up to 50% of the qualifying costs
	Wero Capital Partnership Scheme (ZCPS)	Offering one-stop solution for retrofits, including provision of financial options, application of grants of incentives
Indonesia [3]	Green Building Program	Cost estimation for EDGE software implementation in the frame of retrofitting buildings projects
	Green Building Code implementation – Tax Incentives	Provide Some tax benefits for green commercial buildings
	Renewable Energy Incentives	Tax facility for renewable energy in the form of Income
	EE revolving fund	Provide technical assistance to develop a concept and a program for a revolving fund, via the Project Implementation Plan (PIP) mechanism
Malaysia [3]	Fiscal Incentives for Energy Efficiency - 2001	Tax incentives for promoting EE projects and equipment
	Save Program - 2011	RM 100-200 rebates on refrigerators air-conditioners and chillers

	Green Technology Finance Scheme – 2013	2% subsidy to the interest rates offered by commercial banks and credit-guaranteed support for the loan capital
	Green Investment Tax Incentive – 2014	Green Investment Tax Allowances (GITA) for the purchase of green technology equipment/ assets and Green Income Tax Exemption (GITE) for green technology service providers
Philippines[3]	Feed-in tariff (FIT) program	- Pay companies for energy generated through non-generated through non-conventional measures - 7-year tax holiday for renewable energy developers and the ability to import technologies from abroad duty-free for 10 years
Vietnam [3]	Economic incentive	- Import duty exemption for clean technology products - Incentive tax rate of 10 % for 15 years - Tax reduction of 50% with tax exemption for 4 years on new projects
India	Government incentives to IGBC-rated Green Building Projects and GRIHA applicated projects	Offer different incentives by local government - Offering fast track environmental clearance for green building and township projects - Additional Floor Area Rate (FAR) - Enterprises of MSME sector a subsidy - Offering reimbursement/ reduction of 50% of IGBC Certification fee or consulting charges - and others

Table 3. Economic incentives in Asian countries and India (as of 2017)

The green building practices in these countries demonstrates a growing trend towards incorporating energy efficiency and sustainability aspects into national building standards and codes. These countries have combined mandatory regulations and evaluation tools for voluntary certification schemes to promote green building. In addition, they offer economic incentives to encourage the adoption of green technologies and practices. The following measures identified from the countries included in the case studies are applicable to Pakistan to address the constraints to the adoption of green building.

- **Economic constraints**: Need to support the development of low-cost green building technologies and materials
  - (India) Local governments develop and implement government incentive programs tailored to their own circumstances to promote green building practices.
  - (Brunei, Thailand, Singapore, Malaysia) Provide tax exemptions, low-interest loans, or funding/grants for businesses.

- (Vietnam) Four-year tax exemptions and other tax incentives for new projects.

- **Government structure**: Federal and local governments
  - (Vietnam, India, Singapore) Expedited permits and financial support including fast-track, one-stop solutions.
  - (Indonesia, India) It would be beneficial to leverage decentralized government structures to encourage local governments to develop and implement their own green building codes. To this end, the central government can provide guidelines and technical assistance, while local governments can develop policies tailored to their own local conditions. It is recommended that green building mandates be introduced for buildings over a certain size in major cities, with the intention of gradually expanding the program to other cities.
- **Lack of human resources and skills, awareness building:** Need for a variety of support and programs (workshops/campaigns, etc.)
  - (Malaysia, Philippines, Vietnam) Tax exemptions or other incentives for foreign skills and experts.
  - (Singapore, Indonesia) Capacity and awareness building: Funding to support collaborative design workshops and simulation studies.
  - (All countries other than Singapore) Introduce their own voluntary green building certification systems to encourage building owners and developers to achieve higher levels of sustainability.
- **Monitoring and verification systems**: Build a robust monitoring and verification system to ensure compliance with green building standards and measure the effectiveness of the measures taken.

To promote green building in Pakistan, it is essential to benchmark successful cases of other countries and develop policies tailored to the country's circumstances and resources. This will require introducing energy efficiency regulations and incentive programs, developing low-cost technologies, strengthening cooperation with local governments, promoting public-private partnerships, and conducting education and awareness campaigns. These measures will help create a favorable environment for sustainable green building in Pakistan.

IV. Context and Strategic Directions for Green Buildings in Pakistan

This chapter examines literature related to green building in Pakistan and considers the directions envisaged in previous studies. Based on these findings, we conduct a SWOT analysis to identify strengths, weaknesses, opportunities, and threats and set a strategic direction to move forward.

1. Fact-finding Survey in Pakistan

1) Pakistan: Country Overview

Name	 Islamic Republic of Pakistan	Capital	Islamabad
Area	796,000 ㎢	Population	230 million (2020, World Bank)
Ethnicity	Punjabi (44.7%), Pashtun (15.4%), Sindhi (14.1%), etc.	Religion	Islam (state religion) 96.4%, (85–90% Sunnis, 10–15% Shias), Hinduism, Christianity, etc.
Languages	Official languages (English, Urdu), Punjabi (39%), Pashtun (18%), Sindhi (15%), Balochi (3%), etc.	Government	Cabinet government (bicameral) – 100 Senate members and 342 Lower House members
Major industries	Textile, sewing, agriculture, food processing, etc.	Economy	Gross Domestic Product (GDP): $376.5 billion (2022, EIU) Per capita GDP: $1,596 (2022, EIU) Growth rate: 6.2% (2022, EIU)

Table 4. Pakistan: country overview

With a population of 235 million in 2022, Pakistan is the fifth largest country in the world and the 41st largest economy with a GDP of $346.3 billion. The country's growing population is impacting power demand, presenting a challenge for the energy sector. While 60% of the population lives in rural areas and 40% in urban areas[4], more than 60% of electricity is consumed in the capital region, which presents challenges related to grid instability and limited access in rural areas. This situation is reflected in the country's per capita energy consumption, which is one of the lowest in the world[5]. To address the energy shortage, the Pakistani government has announced the 2013 National Power Policy, the 2015 Power Policy, and the 2019 Alternative and Renewable Energy Policy[6].

Pakistan's economy encompasses a diverse range of industries. As of 2022, the primary industries, including agriculture, accounted for 22.35% of the nation's GDP. The secondary industries, including manufacturing, accounted for 20.42%, and the tertiary industries, including services, accounted for 52.19% [7]. Pakistan's major industries include textiles,

apparel, food processing, dairy products, fertilizers, pharmaceuticals, building materials, and paper. In terms of total electricity consumption, residential demand outweighs industrial demand.

Population growth and the lack of sustainable, eco-friendly technologies, coupled with ever-increasing materials consumption, have caused waste disposal and housing issues. In particular, water scarcity and water quality-related health and sanitation are considered serious issues in Pakistan. Pakistan's per capita water availability is approximately 1,071 m3 per year, and the country is rapidly moving from a water-stressed country to a water-scarce country. A 2020 survey revealed that only 36% of the population has access to safely managed drinking water, with almost 70% of households using contaminated water as potable water[8]. Approximately 60% of the groundwater, which is a source of water for more than 90% of the population, is exposed to E. coli. Furthermore, the estimated safe water supply rate, which is a target under the SDGs, is approximately 20%[4]. Moreover, Pakistan's Building Energy Code (EP-2011) mandates indoor design temperatures of 21°C in summer and 26°C in winter. However, many local residential buildings lack the capacity to provide these comfortable temperatures for residents[9].

2) Climate and Building Characteristics and Energy Consumption by Region/Major City

- **Climate and Building Characteristics and Energy Efficiency Measures**

The establishment of green building standards for Pakistan and the achievement of energy efficiency in sustainable green buildings necessitates an understanding of the climate conditions of different parts of the country. In general, Pakistan is situated within the hot and dry subtropical climate zone. Its summer weather is characterized by high temperatures and frequent rainfall. From December to January, the temperature drops to 0-1℃.

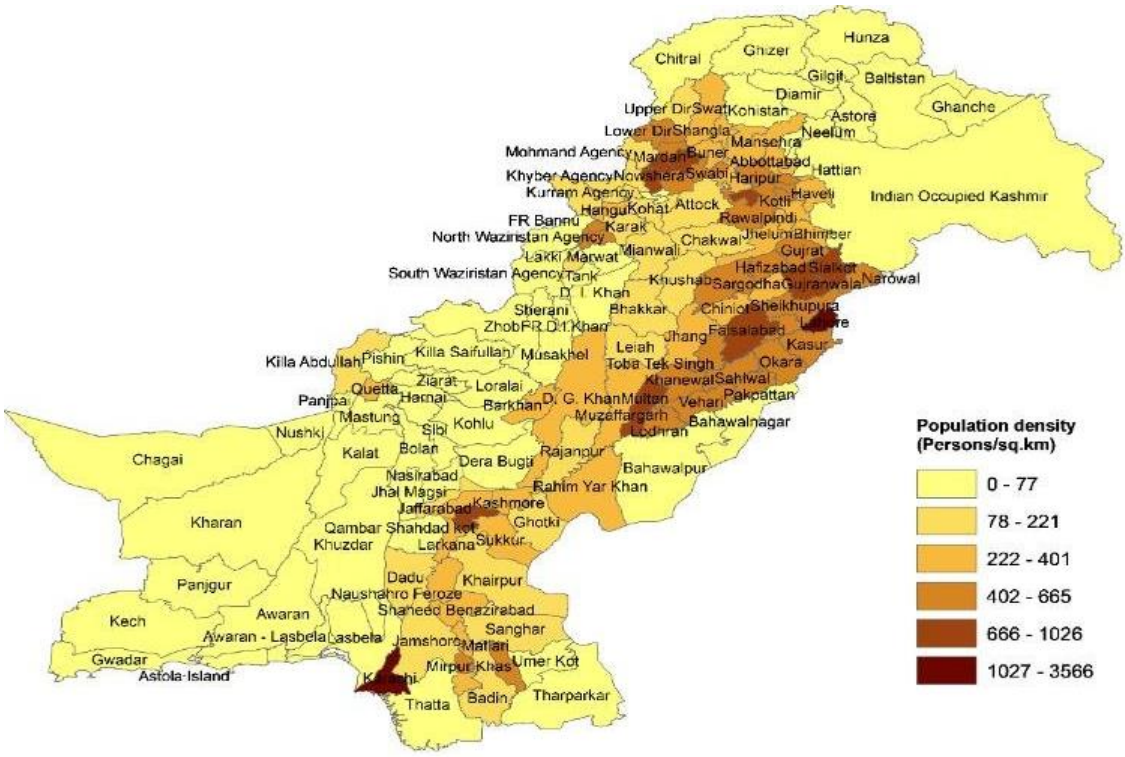
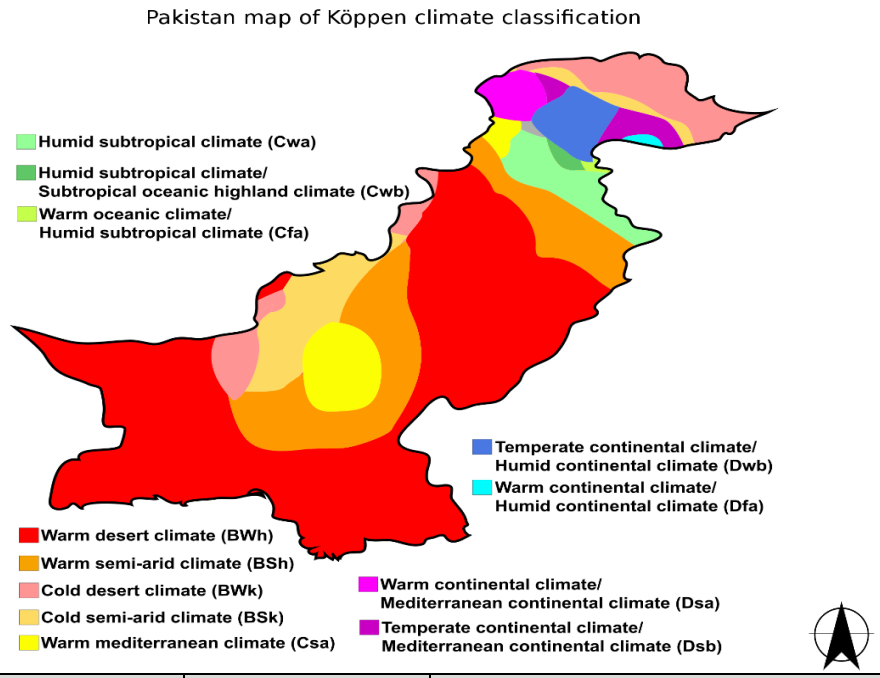


Figure 6. Population density by region in Pakistan: The population density of cities is as follows: Karachi > Lahore > Faisalabad > Rawalpindi > Gujranwala. Most major cities, except for the southern coastal city of Karachi, are located in the eastern part of Pakistan. Islamabad, the capital, is the 9th largest city.

Table 5 illustrates the diverse climatic conditions observed across various municipalities in Pakistan. The mountainous northern region is characterized by an alpine climate, while the central Punjab region features a subhumid temperate climate with high temperatures and torrential rains during the summer monsoon, and cool winters. The climate in the southern, southeastern, and southwestern regions is a combination of subhumid temperature and dry desert climate conditions[10]. This indicates that buildings in southern Pakistan would require more cooling, while those in northern Pakistan would need more heating. In addition, cities that experience greater seasonal fluctuations and temperature extremes, such as Quetta and Balochistan, would require both cooling and heating[9]. However, more than 60% of Pakistan's electricity is consumed in the capital region and the population is primarily concentrated in other major cities (Figure 6). Given that 70% of the country's land falls under a climate zone where it is sunny and hot all year round, the primary purpose of building energy consumption is for cooling, and this should be considered in building energy design. Currently, 55% of the country's energy resources are consumed for cooling, yet buildings still do not provide a comfortable living environment [11]. Table 5 provides an overview of building energy efficiency measures that can be applied in different regional climate contexts.

(Image source: [12])



Region	Climate conditions	Energy efficiency measures
Central (Lahore and Islamabad)	Subtropical climate with hot summers and mild winters	• The relatively high power consumption in major cities provides a rationale for energy efficiency plans to minimize the use of artificial lighting and cooling systems, which can be achieved by focusing on natural ventilation, shading, and insulation.
West (Balochistan)	Desert climate with hot summers and cold winters	• The southwest features one of the world's highest Global Horizontal Irradiance (GHI) [8] → Justification for the use of solar panels. • Designing buildings with passive cooling and heating systems, such as using natural light, helps reduce energy consumption and promote sustainability. • Insulation plans are essential for energy efficiency.
Mountainous northern region	Cold winters with heavy snowfall	• There is a strong need for proper insulation and energy-efficient, sustainable heating systems. • Building designs that maximize natural light help reduce energy consumption.
Coastal region (Karachi and southern coasts)	Hot and humid summers	• Building arrangements that takes into account the amount of sunlight, shading, natural ventilation, and passive cooling systems are required to maintain a comfortable indoor environment.

Table 5. Pakistan's regional climate conditions and energy efficiency measures

Pakistan is also being severely impacted by the recent rapid climate change. The most frequent and complicated extremes are heat waves and droughts in the Balochistan and Sindh areas. In 2022, the highest summer temperature recorded in Sindh's Jacobabad was 51℃. While precipitation has increased globally by an average of 0.08 inches per decade since 1901, some of Pakistan's arid areas have become drier with below-average precipitation. In the central region, the lowest temperature in summer is ever rising, and variability in precipitation continues to increase in Sindh and Gilgit Baltistan (GB)[13]. In addition, increases in effluent of glacial water from Pakistan's glacial lakes pose risks for major floods, as in the disasterous cases in 2010 and 2022[14]. These all highlight the need for considering energy efficiency, buildings' disaster resilience, and water storage capacity in the green building legislation. It is recommended that Pakistan introduce green building institutions and policies that take into account different geographic and climate conditions to encourage provincial governments to develop green building master plans tailored to their own conditions. This will ensure the construction of energy-efficient buildings optimized for each region.

- **Infrastructure in Major Cities and Regions**

Islamabad, the capital of Pakistan, is a relatively small city with a population of 20 million, making it the ninth largest city in the country by population. It is known for its high standard of living and infrastructure, as it is home to many government officials and is the political center of the country[15]. Lahore and Faisalabad are known for their strong industries, and Karachi for its financial sector, being home to the stock exchange and the headquarters of many banks. The characteristics of Pakistan's five largest cities are summarized in Appendix 1.

Karachi, in Sindh Province, is the largest city in Pakistan with the highest number of skyscrapers. However, the city slipped in the livability rankings in 2016, mainly due to rapid population growth, inadequate housing infrastructure, and poor urban planning and transportation policies[16]. Four of the top-ranked major cities are located in Punjab Province. The cities of Lahore, Faisalabad, Rawalpindi, and Gujranwala have economic advantages and are socially stable, either because of their strong textile, manufacturing, and agricultural industries, which each play an important role in the country's GDP, or because of direct support from the provincial and federal governments to develop them as industrial hubs. In other words, local governments in Sindh and Punjab are in a better

position than other municipalities to develop policies and pursue pilot projects related to zero energy and green buildings.

■ **Energy Consumption in the Building Sector**

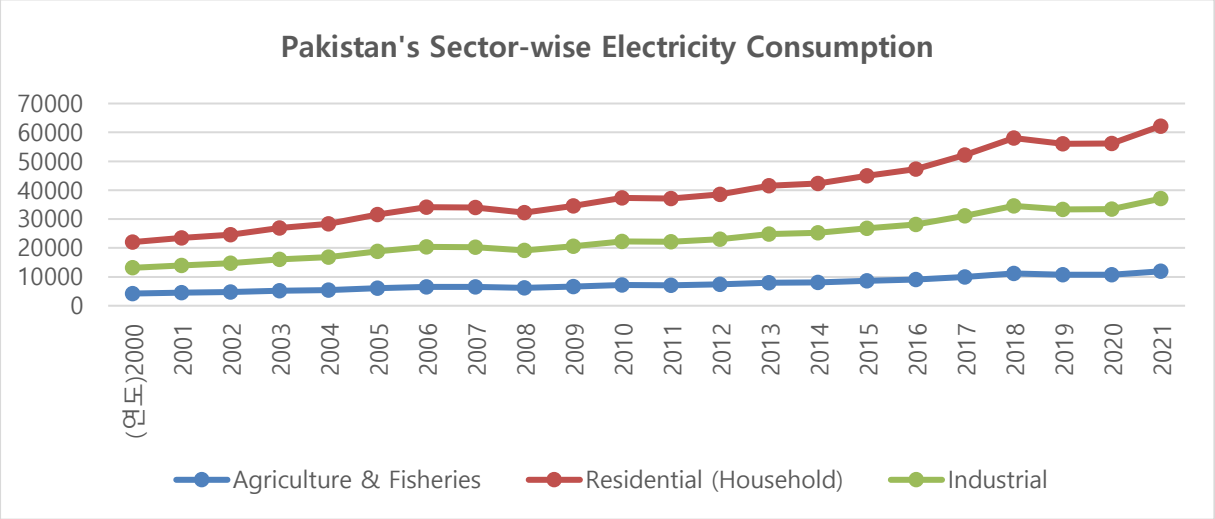


Figure 7. Electricity consumption by building use in Pakistan

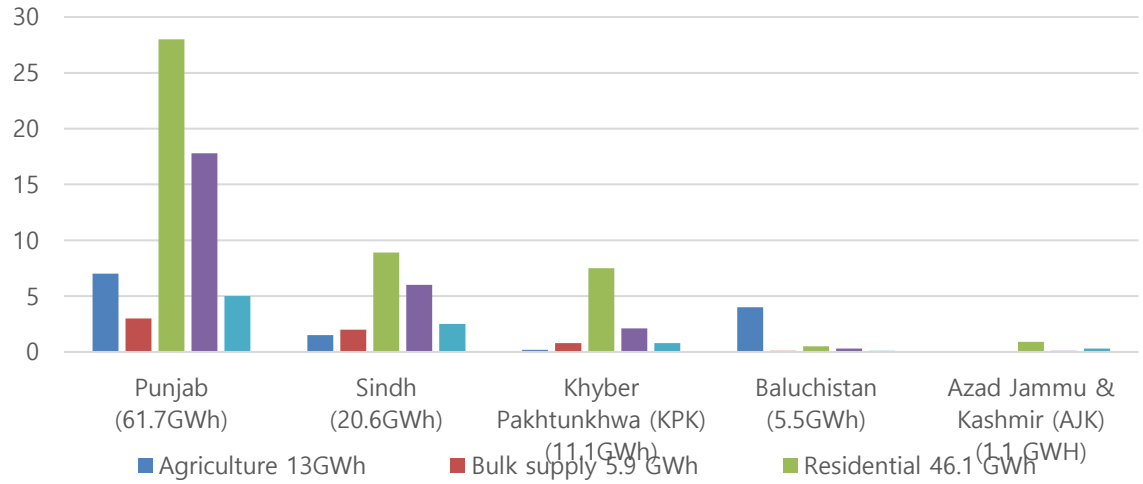


Figure 8. The population distribution by industry and energy consumption in each region (Original Data: [17])

In Pakistan, the residential sector consumes more electricity than any other sector, including industry. It has been growing steadily since 2000 (Figure 7). This may be related to population growth as well as increased use of appliances.

Previous statistical data indicates that more than 40 million people would be living in urban areas in Pakistan by 2023[13]. The pace of this urbanization is predicted to accelerate, leading to a 5.3% annual growth in demand for new buildings [18]. This rapid population growth and changing lifestyles are associated with increased energy consumption and

supply challenges. In addition, the global challenge to drastically reduce carbon emissions and the insufficiency of green energy and existing electrical energy supply chains also affect the country's economy. Figure 8 shows the distribution of population and energy consumption by region. In four provinces, except Baluchistan, the residential sector consumes more energy than other sectors.

The Building Energy Code has evolved since the 1990s. It forms the framework for Pakistan's energy management policy, along with the Energy Provisions 2011. However, it primarily covers commercial buildings and does not focus on single or multi-household homes[9]. In Pakistan, the overall building market for 2018-2025 is estimated to be 79% residential and 21% commercial, with the number of multi-household dwellings far outnumbering single-household dwellings due to the high level of urbanization[19]. It is estimated that approximately 35% of Pakistan's total electricity is consumed by the building sector, of which 85% is consumed by residential buildings[20], [21]. This highlights the need for the Building Energy Code to include measures to address carbon emissions, which are estimated to be 2,487 tons[18], in the building sector. In addition, it is essential to develop a green building code and standards to create an institutional framework that complements or integrates with the BEC.

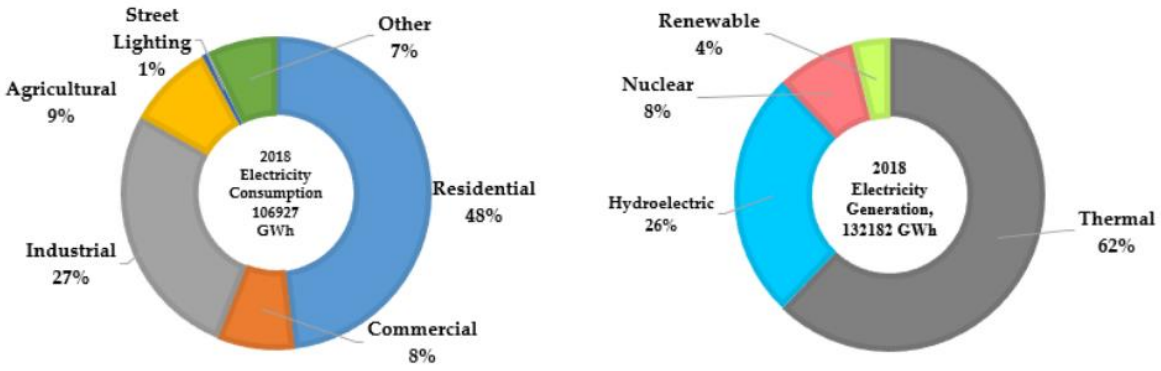


Figure 9. Example of electricity generation and consumption of Pakistan in 2018 [22]

- **Energy Consumption by Building Area**

Floor area has a positive linear relationship with the energy consumption of a building, which should be examined in the local context. Typical urban buildings in Pakistan are

measured in units called "Marles[2]" or "Kanal", and the electricity consumption of residential buildings in Pakistan depends on the floor area and the number of households (Table 6). A typical household in Pakistan consists of 4 to 10 people, although there are exceptions of large families of 15 people or more[23].

No	Plot area		Covered area	Conditioned space	Minimum	Maximum	No. of people
	Marla	m2	m2	m2	(Electricity consumption KWhj)		
1	5	105	95	12-24	100	684	6-12
2	10	211	167	16-54	250	1000	
3	20	418	367	48-85	450	3000	

Table 6. Typical Energy Usage by Building Area (Source of Original Data: [23])

In all three types of urban residential buildings in Pakistan, monthly electricity consumption peaks during the winter and summer seasons(Figure 10). In particular, the peak energy load is observed on weekends and in the evenings during the summer months of May to October, due to the use of air conditioning systems for residential spaces. Residential energy consumption in Pakistan is dominated by electricity for air conditioning, and natural gas is used for cooking, heating, and hot water. The majority of urban dwellings in Pakistan are one- or two-story houses. According to the Pakistan Bureau of Statistics, more than 90% of these houses are owner-occupied[23].

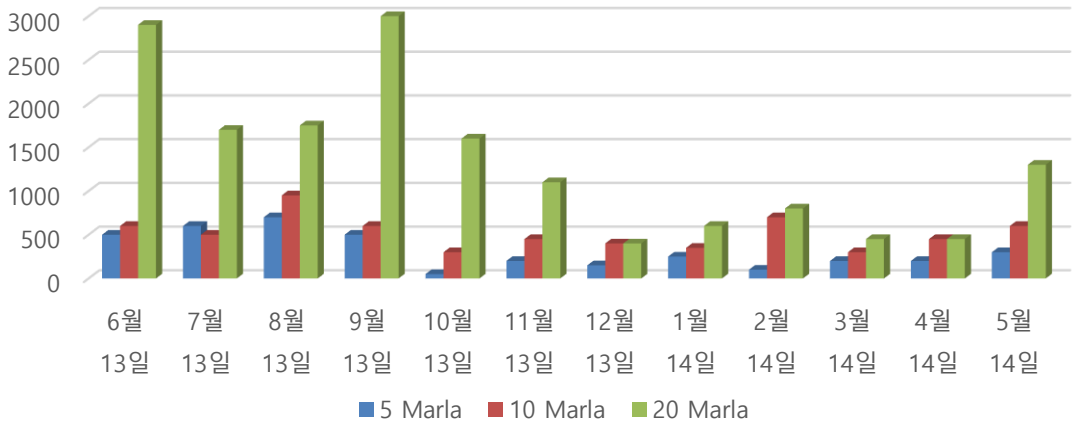


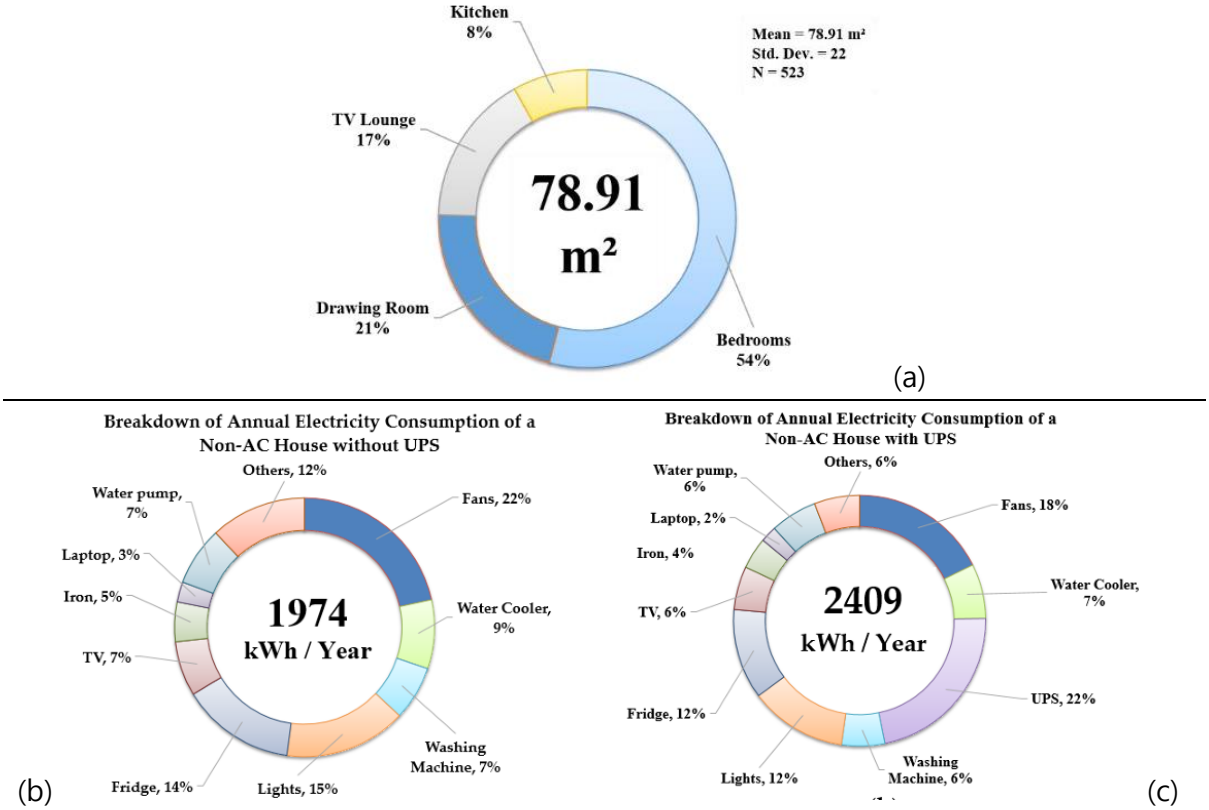
Figure 10. Monthly Electricity Usage in Urban Homes in Pakistan by Area (Source of Original Data: [23])

2 1 Marla is approximately 30 m^2. 1 Kanal is 20 Marla, which is equivalent to 400 m^2 of covered area.

Understanding the various aspects of energy consumption and conducting research, with particular emphasis on comprehensive data collection, is a prerequisite for improving the energy efficiency of residential buildings in different climatic zones of Pakistan and establishing appropriate sectoral standards.

For instance, a study aimed to collect data from 523 households in the city of Mirpur in Pakistan. Monthly electricity bill data, surveys, and interviews were used to profile the monthly electricity consumption of these households. The results showed that 61% of the respondents in Mirpur lived in single-story houses and 36% in multi-story houses. Only 2.29% of the respondents lived in apartments or residential plazas. The average floor area of the multi-story houses was 89 m^2 and they consumed an average of 33 kWh/m^2 of electricity per year, 27% more than the single-story houses. This is because multi-story houses have a larger floor area and use more electrical appliances. On the other hand, the average annual electricity consumption of apartments was 44 kWh/m^2, which is probably due to the fact that appliances in common areas of apartment buildings run longer and their operation is not properly monitored. It may also be due to the fact that apartment buildings are taller than surrounding buildings and therefore exposed to sunlight for longer hours[22].

The average floor area of a typical single-story house in Mirpur surveyed in this study was 78.91 m^2, and as shown in (a) of Table 7, the bedroom occupied the largest portion of the total floor area at 54%, followed by the living room at 21%, the TV lounge at 17%, and the kitchen at 8%. The figures in (b) and (c) of Table 7 show the breakdown of annual electricity consumption, with fans, lights and refrigerators consuming the largest amounts of electricity. This is partly due to the use of inefficient appliances.



Room	Average Number	Dimensions and Frequency	Average Floor Area/ Room (Each)
Bedroom	3.2	12′ x 14′ (51%) 10′ x 12′ (45%)	13.47m^2
Drawing Room	0.96	12′ x 14′ (48%) 14′ x 16′ (43%)	18.30 m^2
TV Lounge	0.72	14′ x 16′ (51%) 12′ x 14′ (42%)	17.90m^2
Kitchen	1	8′ x 10′ (60%)	6.27m^2

Table 7. Percentage distribution of average floor area of a typical house in Mirpur city, Breakdown of Annual Electricity Consumption of a Non-AC house with / without UPS, Average floor area of a typical house in Mirpur city (down)[22]

(a) (b)

Figure 11. Typical house and residential flats in Mirpur city. (a) Double-story house and (b) Flats. Figure 4. Typical house and residential flats in Mirpur city. (a) Double-story house and (b) Flats (출처: Unlocking household electricity consumption in Pakistan[22])

Understanding these regional characteristics of residential buildings and their electricity consumption profiles should be a priority in the development of effective energy policies, rating systems, and detailed criteria. It will also contribute to the forecasting of future energy demand and the design of measures to address the use of inefficient electrical appliances.

■ The Use of Local Building Materials and the Need for the Reinterpretation of Passive Design

The predominant materials used in Pakistan's vernacular architecture were mud and clay. Clay regulates temperature by absorbing and releasing moisture during precipitation. Given the lowest heat transmission coefficient, clay also is a highly energy efficient material (Shah, 2020). However, driven by rapid urbanization, clay is increasingly replaced by cement concrete block walls, kiln-fired bricks, and reinforced cement concrete roofs. Table 8 shows the most commonly used building materials.

Envelope component	Structural component	Insulation materials [24])
Wall	1. Brick 2. Mud 3. Cement	1. Glass wool 2. Expanded polystyrene (25m, 40m, 50mm) - Molded beads - Extruded 3. Expanded polyurethane (25m, 40m, 50mm) - Molded beads - extruded
Roof	1. T-iron guarder (girder) 2. Wood 3. Sarkanda/ Sirkiyan 4. Concrete	

Floor	1. Mud 2. Cement 3.Tiles 4.Chips 5. Brick 6. Marble	4. Vacuum insulation panel (VIP)
Fenestration	Single pane with frame (wood, vinyl, fiberglass, metal like aluminium frames)	Double glazed with… 1. Low thermal conductivity gas fill 2. Electro chromic glazing 3. Holographic optical elements 4. Aerogel glazing 5. Spectrally selective glass coatings (lowE)

Table 8. Common Building Facade Materials Used in Pakistan [23], [25]

Inefficient design resulting from urban sprawl and high population density is a major contributor to the deterioration of the quality of living environments and the increase in energy consumption for heating and cooling. The high cost of materials, the prevalent use of sub-standard materials, and the lack of specialists in functional window systems result in the predominance of single-glazed windows, which negatively affect the thermal efficiency of buildings and increase energy consumption. Other challenges include difficulties with natural cross-ventilation, poor space design, inadequate storage ventilation systems, lack of consideration for dust storms and ventilation, orientation and thermal comfort issues, and low material and construction quality[23].

According to a report by ENERCON in Pakistan, improved building design can reduce residential energy costs by 20%, or coupled with the use of energy-efficient appliances, by 50%[20]. Pakistan is located in a temperate climate zone, and according to the Energy Conservation Building Code 2023, a significant reduction in energy consumption can be achieved by using appropriate building materials with insulating properties in the temperate climate region.

Data on the use of building materials for roofs and walls in Pakistan (Table 9, Table 10) show that concrete and brick are the predominant roofing materials in urban areas, while bamboo and truss roofs are the predominant roofing materials in rural areas. The brick walls of Pakistani vernacular buildings provide good thermal regulation in hot climates, but there are problems that need to be addressed, such as poor performance due to the

use of low-quality materials, inadequate seismic and flood resistance, and lack of relevant building codes and legislation.

The use of brick and concrete is expected to increase in urban areas as urbanization progresses, which in turn will exacerbate the heat island effect caused by the use of concrete. This underscores the need to develop measures using sustainable materials. Following the urbanization trend, bamboo, while still a dominant choice in rural areas, is becoming less preferred in urban construction. The use of this and other sustainable materials should be promoted in both urban and rural areas. It is also a challenge to meet the resilience and aesthetic requirements using modern technology[26].

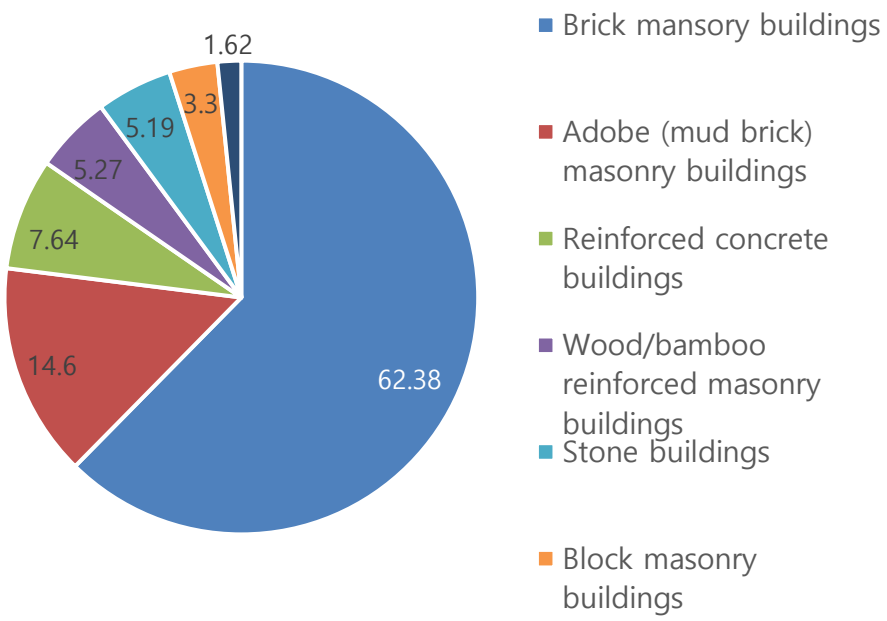
Province & District	Materials Used for Walls				
	Burnt Brick/Block	Mud Brick/Mud	Wood	Others	Total
Pakistan	79.84	15.32	1.62	3.21	100.00
Urban	95.95	2.94	0.46	0.65	100.00
Rural	69.68	23.13	2.35	4.83	100.00

Table 9. Housing Units in Pakistan by Construction Material (Source: Pakistan BUREAU of Statistics 2019-20[26])

Province & District	Materials Used for Roofs					
	RCC (Reinforced Cement Concrete) /RBC (Reinforced Brick Concrete)	Wood/Bamboo	Sheet/Iron/Cement	TR Girder Roof	Others	Total
Pakistan	33.31	22.86	4.05	39.19	0.59	100.00
Urban	59.74	6.63	4.85	28.29	0.49	100.00
Rural	16.64	33.09	3.55	46.06	0.65	100.00

Table 10. Percentage Usage by Material Used in Roofs (Source: Pakistan BUREAU of Statistics 2019-20[26])

There is an opportunity to take advantage of these characteristics of clay and other vernacular building materials and develop ways to translate them into modern building techniques that are appropriate to Pakistani conditions. Combining traditional wisdom with modern practices would result in a uniquely Pakistani green building with improved sustainability and energy efficiency.



In addition to materials, green building techniques for energy efficiency can also be found in the design elements of Pakistan's vernacular architecture. The vernacular architecture of Pakistan's provinces and rural areas has developed excellent passive design strategies based on the experience of past inhabitants, such as courtyard design adapted to regional climates, stairwell design, natural lighting and shading, ventilation, orientation, and thermal efficiency.

Establishing green building practices for the local climate of Pakistan requires taking advantage of the materials used in vernacular architecture and its passive building elements and translating them into new green building techniques. A prime example of this is the "Zig-Zag Kiln", a reinterpretation of vernacular architecture for energy efficiency and environmental mitigation using bricklaying techniques[27]. Appendix 2 shows the characteristics of vernacular building styles and materials for different climate zones in Pakistan. Using them for customized green building standards will help develop the market and technology. This will also help develop Pakistan's own green building technologies and set best practices for countries in similar climates.

3) Existing Building Policies, Laws and Institutions in Pakistan

■ **Government Organization and the Federal Government**

1)

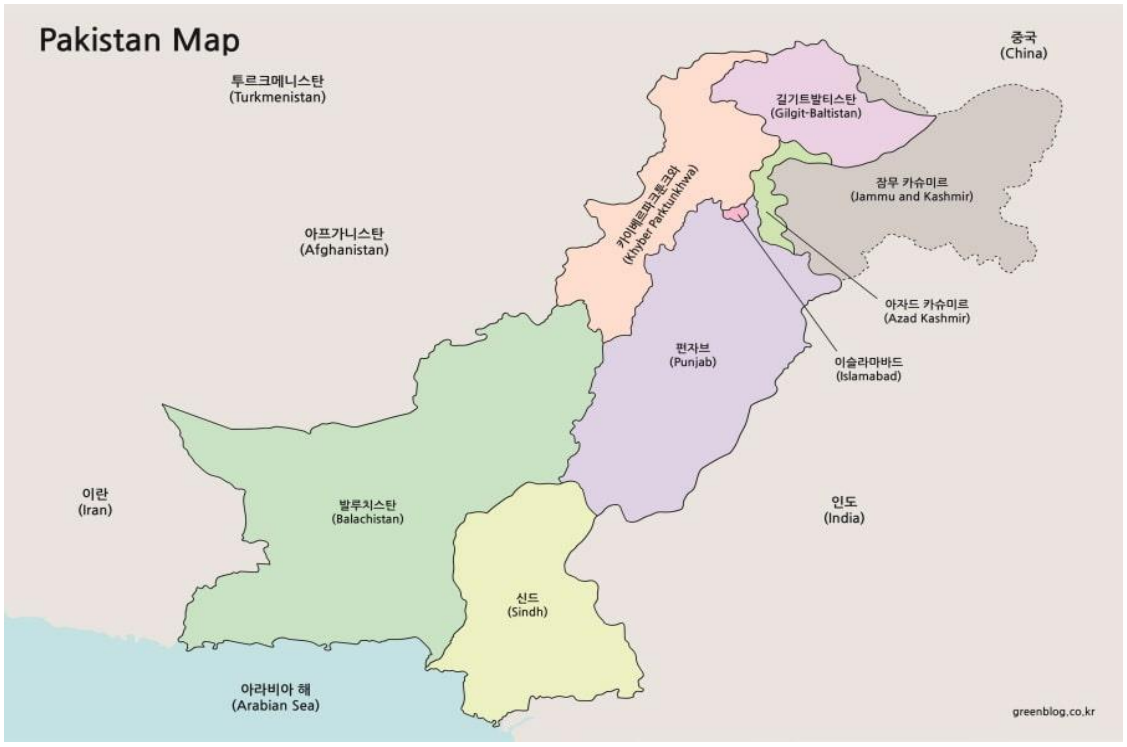


Figure 12. Map of Administrative Divisions in Pakistan (Source: greenblog.co.kr)

The government of Pakistan consists of the executive, legislative (Senate and National Assembly) and judicial (courts). It operates under a parliamentary system in which the Cabinet is the final decision-making body and the Prime Minister is the head of government. The Senate has 104 members and the National Assembly has 342 members. The current 22nd cabinet consists of 31 members, including the prime minister and the ministers of defense, economy, foreign affairs, and other ministries. The Prime Minister is the head of state and is elected by the National Assembly for a five-year term. As the head of state, the president of Pakistan is more of a symbolic position and the political system is primarily driven by the parliamentary system where the prime minister holds the real power.

The administrative units of Pakistan are one federal territory, two disputed territories, and four provinces. The governmental structure of Pakistan is divided into central and local governments. The local governments consist of four provincial governments - Punjab, Sindh, Khyber Pakhtunkhwa and Balochistan - headed by non-executive governors appointed by the President and governed by local laws. The two disputed territories -

Gilgit Baltistan and Azad Jammu & Kashmir, a disputed territory with India - which operate independently of the judicial, legislative, and executive branches of the central government, except for diplomacy and defense. The current capital of Pakistan, Islamabad, and the National Capital Region form the federal territory. The central government is a federal government established under the Constitution and has sovereignty over all provinces. The federal government consists of the legislative (Senate and National Assembly), judicial (courts) and executive. The federal government operates under a parliamentary system, and the Cabinet is the final decision-making body of the government, headed by the Prime Minister.

■ Pakistan's Policy Trends in Energy and Climate Change Adaptation

Institution	Ministry of Energy	National Energy Efficiency & Conservation Authority	National Electric Power Regulatory Authority	Alternative Energy Development Board	Private Power & Infrastructure Board, PPIB
Roles	- Responsible for establishing and implementing the country's overall energy policy	- ENERCON reorganized into NEECA in 2016 - Develop programs and policies to improve energy efficiency, disseminate energy-saving technologies, and establish and monitor energy efficiency standards	- Power regulation and management: Issue production, transmission, and distribution permits and supply power to consumers - Establish and implement standards to ensure quality and safety in operations	- Established to promote the development and utilization of renewable energy resources	- Established to attract private investment to expand power infrastructure and ensure stable power supply

Table 11. Major Energy-related Institutions in Pakistan

In the energy and climate change sectors, Pakistan has institutional arrangements at the federal and local levels for policy, regulation, operations, and implementation. As shown in Table 11, federal institutions include the Ministry of Energy, the National Energy Efficiency & Conservation Authority, and the National Electric Power Regulatory Authority,

while the Alternative Energy Development Board and the Private Power & Infrastructure Board are responsible for supporting the development and deployment of relevant technologies. In addition, the Pakistan Engineering Council (PEC) supports the federal and local governments and is responsible for engineering education, certification, professional regulation, and licensing. Local government institutions include provincial energy efficiency and conservation agencies, such as the Punjab Energy Efficiency & Conservation Authority.

In 2013, Pakistan announced the National Power Policy 2013 (NPP-13) and the Framework for Implementation of Climate Change Policy, 2014-2030 (FPCP) to address the issues of power shortage[3] and climate change. More recently, the Renewable Energy Policy, 2006 (RE Policy 2006) was replaced by the Alternative Energy Development Policy, 2019 (ARE Policy 2019), which aims to increase the share of renewable energy from 5% in 2020 to 30% in 2030. In 2021, the National Energy Efficiency & Conservation Authority (NEECA) began developing minimum energy performance standards (MEPS) for electric motors, air conditioners, and LED lighting. NEECA's draft National Strategic Plan (2020-2023) envisioned a reduction of 3 million tons of oil equivalent (MTOE)[4] from the country's primary energy supply, contributing to a reduction in carbon emissions of 6.4 MtCO2e[13]. However, the actual implementation of many of these policies remains questionable due to the political-economic situation and natural disasters.

- **Green Building Policies, Laws and Institutions in Pakistan**

There are currently four building codes in Pakistan.

- Building Code: Building Code of Pakistan (BCP) established in 1986 and amended in 2021.
- Seismic Provisions: Established in 2007 and included in the Building Code.

[3] *In Pakistan, 27% of the population lacks access to electricity due to the country's growing population, poor transmission infrastructure resulting in significant power losses (18%), and difficulties in policy implementation. The shortage is particularly severe in rural areas[15].*

[4] *Industry (1.3 Mtoe), buildings (0.5 Mtoe), transportation (0.5 Mtoe), electricity (0.4 Mtoe), and agriculture (0.3 Mtoe) (Source: Ministry of Energy, Pakistan). In 2018, Pakistan's emissions were 489.87 MtCO2e.*

- Energy Code: Published in 2008 (BECP) and included in the Building Code as the Pakistan Building Energy Code (EP-2011) in 2011; promulgated in 2013; amended as the Energy Conservation Building Code 2023 (ECBC-2023) in 2023.
- Fire Safety Provisions: Established in 2016 and included in the Building Code.

Building codes and standards applicable to different regions of Pakistan are formulated by local governments, including development authorities, municipalities, and provincial boards. They define the basic requirements for occupant safety, health, accessibility and protection against hazards, earthquake, fire and structural protection of buildings in their respective jurisdictions[1]. In the past, the PEC was directly involved in the development and implementation of building codes through the organization of task forces, and ENERCON (National Energy Conservation Center) was involved in the development of energy codes and standards. Pakistan's current building code system is primarily prescriptive in nature, consisting of provisions and sets of standards that clarify the requirement that buildings be designed, constructed, protected, and maintained for the safety and comfort of the general public[1].

Pakistan's existing building code system focuses primarily on standards and legislation to meet the stringency requirements of certain elements, such as materials and equipment, related to the safety and amenities of buildings, including earthquake and fire (top of Table 12). On the other hand, the EU Switchasia framework presents a system of green building codes, as summarized at the bottom of Table 12. The system consists of three components: legislation, standards and practices, and design and assessment.

Green building codes take a performance-based approach through evaluation and design to determine whether a building complies with green building principles. This supports the effective implementation of green building practices, and regular revisions and additions to the codes ensure the achievement of sustainable development goals.

The green building code system should also consider improvements and linkages with current energy and safety standards (fire, structural, etc.).

Relevant legislation		Relevant provisions/codes	Features
Key building codes in Pakistan	**Building Code of Pakistan (2021) (BCP)**	Pakistan Building Energy Code (1990, 2011, 2023) → Replaced by Energy Conservation Building Code 2023 (ECBC-2023)	■ Pakistan's current building regulatory system is prescriptive or specification-based, consisting of codes and standard sets aimed at ensuring that buildings are designed, constructed, protected and maintained for the safety and comfort of the general public (primarily focusing on meeting the stringency of certain elements such as materials and equipment)[1].
		Building Code of Pakistan-Fire Safety Provisions 2016	
		Seismic Provisions of Pakistan Building Code	
Legal/institutional Improvements to Establish Green Building[1]	**Green Building Code**	The functional goals and performance requirements of green buildings should reflect social expectations for building's safety and health levels.	■ Recommend to expand performance-based legal systems that are based on legislation, standards and practices, design and evaluation to the municipal level[28]. * Performance-based codes: Aimed at achieving specific outcomes, rather than meeting prescribed requirements.
	Standards and Practices	Adopted as a standalone reference document to comply with green building code requirements	
	Evaluation and Design	Tools to support the review and validation of green design	

Table 12. Current Major Building Regulations in Pakistan and Improvement Directions for Green Building Establishment Laws and Regulations

BECP (EP-2011) was developed by ENERCON (predecessor of NEECA) in 1990 as a legal system for improving energy efficiency of buildings in Pakistan based on the Indian ECBC. EP-2011 referenced the U.S. benchmark for commercial buildings, ASHRAE 90.1. It was incorporated into the Pakistan Building Code in 2013 to apply to new commercial, industrial, and large-scale construction projects. BECP-2011, which focused on energy efficient building materials, is no longer in effect as it has been replaced by the Energy Conservation Building Code 2023 (ECBC-2023). This new code is also more compatible with related standards from ARI, ANSI, and ASTM, among others. Table 13 shows the updates from the BECP (EP-2011) to the ECBC-2023.

ECBC-2023 provides the framework for minimum performance criteria for the elements prescribed in EP-2011 (building envelope, windows and openings, lighting, heating, ventilation, HVAC systems, etc.). In addition, ECBC-2023 recommends technologies such as passive design, sustainable and renewable energy, electric vehicle charging stations, and water reuse systems. While EP-2011 initially provided a comprehensive set of energy efficiency standards, shortcomings have been identified in some areas compared to the latest international standards. To this end, ECBC-2023 aligns the content and direction of the UN SDGs and the Paris Agreement, and is subject to regular revision every three years.

ECBC-2023 aims to improve the energy efficiency of buildings by promoting the use of green materials. It provides guidance on how to replace traditional building materials with greener options, and includes materials that support energy-efficient building design throughout building operations. Despite these efforts, it may be noted that it lacks quantitative standards. Furthermore, given that Pakistan's residential buildings are predominantly one- and two-story dwellings[23], the applicability of ASHRAE 90.1, which primarily covers standards for high-rise buildings in the U.S., and the feasibility of referencing ASHRAE 90.2, which covers standards for low-rise residential buildings, should be considered.

	Building code of Pakistan (Energy Provision-2011)[25]	Energy Conservation Building Code (ECBC) 2023[29]
Target	• New commercial building and theirs systems • New portions of existing buildings and their systems, if the conditioned area or connected load exceeds the scope below • New systems and new equipment in existing buildings • Increase in the electricity load beyond the limit of the scope below	• The ECBC 2023 applies to both residential buildings and commercial building • New commercial building and theirs systems • New portions of existing buildings and their systems, if the conditioned area or connected load exceeds the scope below • New systems and new equipment in existing buildings • Increase in the electricity load beyond the limit of the scope below
Scope	• Total connected load: 100kW or greater or • **Contract demand:** 125kVA or greater or • **Conditioned area**: 900m^2 or greater or	• Total connected load: 50kW or greater or • **Contract demand:** 75kVA or greater or • **Conditioned area**: 200m^2 or greater or

	• Unconditioned buildings of covered area: 1,200m^2 or more	• Unconditioned buildings of covered area: 300m^2 or more
Mandatory Elements	• Building envelopes • Building mechanical systems and equipment, including HVAC (Heating, Ventilating and Air Conditioning) • Service Water Heating • Lighting • Electrical power and motors	• Building envelopes • Building mechanical systems and equipment, including HVAC (Heating, Ventilating and Air Conditioning) • Service Water Heating • Lighting • Electrical power and motors • Others (Passive Design, Renewable energy, Electric vehicle charging points, water reuse systems, etc)
Case of any conflict	The relevant provisions of Safety, Health, or Environmental Codes shall prevail.	

Table 13. Comparison of Building Code of Pakistan (Energy Provisions-2011). (Detailed version: Appendix 3)

■ Government-led Green Home Building Programs

Pakistan has also attempted to revive its stagnant construction industry through government-led housing projects. Examples include the Ravi River Urban Development Project, the Bundle Island Project, and the NAYA (New) Pakistan Housing Project. The NAYA Pakistan Housing Project, in particular, was funded by the SWITCH-Asia[5] program to conduct green building research and develop green building guidelines, and was a large-scale housing project that aimed to build five million homes in seven areas within five years, with land provided by the government and financing provided by private investors. Despite these efforts and research, the development and establishment of green building institutions seems to have stagnated somewhat due to political and economic issues.

■ Evaluation and Certification Systems

Pakistan does not have its own green building performance rating systems and uses a variety of external criteria and evaluation and rating systems. The Pakistan Green Building Council published the Reference Guide for Building Design and Construction in Pakistan

[5] *A program that provides EU funding for projects that promote clean technologies and sustainable industrial practices in a wide range of sectors (including energy efficiency in industrial plants and housing, agri-food and fisheries, tourism, logistics, etc.*

in 2018, which included the Guidelines for the Selection of Rating Systems[1] to encourage green building design.

- UN-Habitat/UNEP-10YFP/SHERPA: Guidelines for sustainable housing
- Green Rating for Integrated Habitat Assessment, GRIHA
- Leadership in Energy and Environmental Design (LEED)
- Building Research Establishment Environmental Assessment Method (BREEAM)
- Green Star Rating System (GSRS)
- ISBE/SBA 2009/SBAT 2016: Performance evaluation criteria
- Green Design with WB software EDGE (Excellence in Design for Greater Efficiency)
- Comprehensive Assessment System for Built Environment Efficiency (CASBEE)
- EU GB Rating System (zero energy standard)

The U.S. LEED certification has been increasingly recognized since 2008. As of 2018, there were 21 LEED-certified buildings in Pakistan, with the majority located in Karachi and the capital region[19]. Despite its dominance, the LEED certification system is more appropriate for countries in cooler climates, highlighting the need to develop a rating system for Pakistan's hot tropical climate and diverse climatic zones, taking into account cost and economic feasibility[1]. In this context, the approval of green building plans and compliance assessment by building control authorities should progressively aim at developing and achieving green performance certifications tailored to Pakistan's culture, architectural traditions and local climate.

The green building guidelines released in 2020 for the New Pakistan Housing Project (NPHP), which aims to build five million new homes, recommends the use of EDGE simulation software to assess the resource efficiency (energy, water, and materials) of buildings constructed under this housing project. The EDGE software is a residential building design and assessment program that is broadly applicable to different income groups and building types. It enables the selection of resource efficiency measures according to local conditions and needs, thus providing more flexibility[30].

Under NEPRA's Net Metering Program (2015), more than 2,300 new licenses were issued from July 2019 to March 2020[13].

4) Construction Market and Green Building Support and Incentives in Pakistan

■ Construction Market in Pakistan

Pakistan's economy has demonstrated stable growth since the 2000s. According to the Pakistani Ministry of Finance, the construction market accounted for 2-2.5% of the country's GDP prior to the economic crisis. Historically, the construction industry had grown at an average annual rate of 6-8% before slowing down due to the 2008 global financial crisis, the 2021 earthquake, the 2022 floods, and the 2020s pandemic. The country is also facing rising construction costs driven by increases in the prices of imported cement, steel, and other building materials, as well as challenges in technological and process development.

The NPHP, which aimed to build five new homes to revitalize the construction market, is currently on hold. Government-led housing projects play an important role in Pakistan's construction market. However, political instability has hampered their progress. Despite this, there is growing importance of renewable energy buildings, which is leading to the emergence of relevant industries and economic support.

A study conducted by the U.S. National Renewable Energy Laboratory (NREL) identified the province of Baluchistan as an optimal location for solar power generation. Indeed, there has been a notable increase in the number of solar panel installations on new buildings in Islamabad and Baluchistan. As part of the Sindh government's initiative, solar panels have been installed in 200,000 homes across 10 districts in Sindh Province. The Sindh Solar Energy Project (SSEP) has invested USD 30 million in solar projects in rural areas with insufficient access to electricity, and the World Bank has provided USD 100 million in funding to the SSEP. The Sindh Solar Energy Project (SSEP) has initiated several flagship projects, including a 400 MW solar park in Manjhand Town, 20 MW of solar installations on public buildings in Karachi and Hyderabad, and solar installations in 200,000 homes in rural areas[31].

Furthermore, pilot projects have been implemented with the objective of stimulating the private market for green, renewable energy, with international support. For instance, the International Finance Corporation (IFC) launched a four-year campaign, "Lighting Pakistan," to promote private investment in lighting projects for consumers in remote villages in Pakistan. Similarly, the AEDB implemented the Off-Grid Electrification Pilot Project in Sindh and Punjab through a results-based financing (RBF) model. The German Agency for

International Cooperation (GIZ, Deutsche Gesellschaft für Internationale Wusammenarbeit) has implemented several small-scale RBF projects in select villages in Punjab and Sindh [13]. Despite the current cost of solar power generation is higher than other renewable energy sources, it is expected that solar will become the preferred choice in the long term due to the local climate and infrastructure conditions. There is a growing number of relevant projects supported by international partners.

- **Economic Support for Green Building**

Pakistan is working with various financial institutions and international organizations to provide economic support for the adoption of green building. In 2017, the State Bank of Pakistan (SBP) approved the green banking guidelines to encourage environmental risk management and climate finance by commercial banks. The green banking guidelines aim to mitigate the vulnerability of banking, fulfill their environmental responsibility, and provide funding needed for the transition of the economy towards a climate and environmentally friendly future.

In 2020, the Green Climate Fund (GCF) approved projects worth USD 7.2 billion, and Pakistan mobilized USD122 million through intermediary finance (UNDP, ADB, FAO). The Ministry of Climate Change (MoCC) supported two domestic organizations in their accreditation process through the GCF to access various financial instruments (grants, grant equivalents, long-term low-rate loans, equity, and guarantees). Below are international climate finance support programs in 2021[13].

- 1 project: Adaptation Fund
- 3 projects: Green Climate Fund (GCF)
- 15 projects complete out of 19 approved projects: Global Environment Fund (GEF)
- Limited access to Climate Investment Funds (CIFs) or key bilateral climate funds and instruments
- 1 project: Nationally Appropriate Mitigation Action (NAMAs)

Housing finance in Pakistan is particularly underfunded, with a housing finance to GDP ratio of 0.25%, one of the lowest in South Asia. In this context, movements to build a

climate-responsive financial system, such as green bonds[6], provide an opportunity to lay the foundation for green finance, including green home mortgages, green home equity loans, and green commercial building loans. To this end, it is important to facilitate private capital investment, streamline project approval processes, and address domestic risk factors so that foreign investors are not deterred from investing in Pakistan.

- **Incentives**

Incentives can be an effective policy instrument to encourage the implementation of the GBC in Pakistan. They may include easing regulations for building area or height, tax exemptions, other tax incentives, lower interest rates on construction loans, and duty-free importation of green technologies or materials.

In April 2020, the Pakistani government announced an incentive package worth over 100 billion Pakistani rupees to stimulate the country's sluggish construction sector. A core element of this incentive package was 10-year financial incentives to investors in the housing industry under the Naya Pakistan Housing Programme, a five-million new home construction project. Typical incentives included tax exemptions, incentives for expatriate Pakistani investors, and incentives worth 36 billion Pakistani rupees. These incentives were scheduled to end in December 2020, but tax exemptions were extended until June 2021 and others until the end of 2021[31]. Below are the summary and highlights of Pakistan's construction industry incentive packages in 2021.

Incentive package	Highlight (effective until December 31, 2021)
Local construction projects in Pakistan	- Tax exemption for local construction projects in Pakistan until December 31, 2021, regardless of the source of the funds.
Naya Pakistan Housing Programme)	- Taxes on investor profits reduced to one-tenth of the current level. - Grants worth 30 billion Pakistani rupees
Tax policy for construction materials	- No withholding tax on all items used in the construction industry except steel and cement
Facilitating new home construction	- Capital gains tax exemption on the sale of houses owned by individuals.

6 Pakistan has issued green bonds through the Water and Power Development Authority (WAPDA). However, challenges remain in developing guidelines and establishing criteria[45].

Adjusting tax policy for builders	- Taxes payable by builders calculated based on construction area instead of their operating income.
Adjusting sales tax conditions for the construction industry	- Sales taxes imposed on the construction industry reduced in consultation with provincial governments.
Adjusting real estate capital gains tax conditions	- Minimum ownership requirement to avoid capital gains tax for the selling of real estate reduced to three years from four years.
Construction Industry Development Board.	- Organized the Construction Industry Development Board.

Table 14. Key Contents of Pakistan's Construction Industry Incentive Package [31]

The effectiveness of these incentives and other initiatives launched after 2021 have not been identified. For the successful and sustainable implementation of the GBC, the effectiveness of incentive programs needs to be reviewed regularly and adjustments should be made accordingly.

■ Green Building Education in Pakistan

In Pakistan, a number of organizations such as the Sustainable Development Policy Institute (SDPI) and the Pakistan Green Building Council have organized workshops and seminars on green building. Below are examples of notable green building programs in Pakistan[19].

- LEED AP Examp Preparation Courses in 2016
- First-ever expo and conference held in Karachi in October 2016
- Two conferences at Greenbuild in 2018
- Five LEED technical workshops in 2018

The Pakistan Engineering Council (PEC) regulates the engineering profession and ensures that engineering graduates meet the knowledge, skills, and ethical requirements. As in the case of the PEC, it would be essential to establish separate or integrated entities to ensure continuous education, training, and skills development at various levels and drive strategies to pursue awareness campaigns.

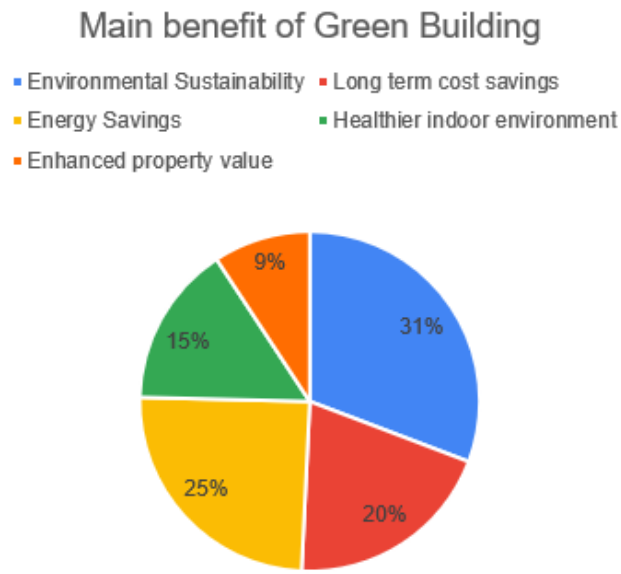
2. Awareness of green building among Pakistan Stakeholders

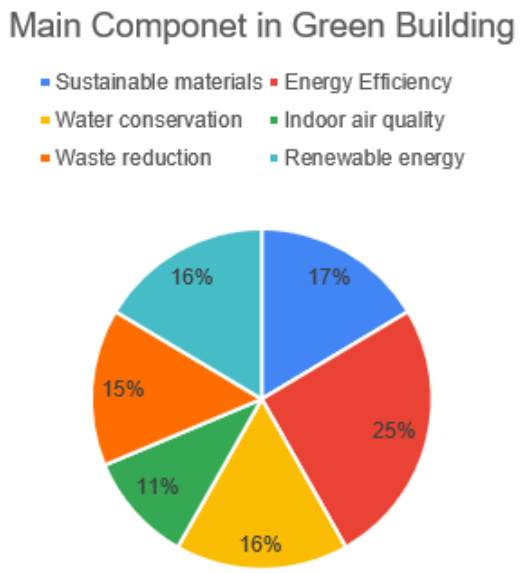
A survey was conducted among relevant professionals in Pakistan to understand the perceptions of professionals in the country and to inform the proposal and roadmap for the green building certification system. The survey focused on reviewing their understanding of green building and NDCs.

As a result, a total of 21 experts (20 men and 1 woman) responded, and it was found that they were not familiar with the system or standards for green building. However, they are aware of the NDCs and agree on the importance of green building and the need to apply it. The most important aspect of green building is energy efficiency, followed by sustainable development, water circulation, and activation of renewable energy, and waste management and indoor air quality management.

In addition, the greatest effects of green building are seen as environmental and economic, and it was suggested that a balanced development of the fields currently covered by green building, such as materials and energy, water cycle, and indoor environment, is needed.

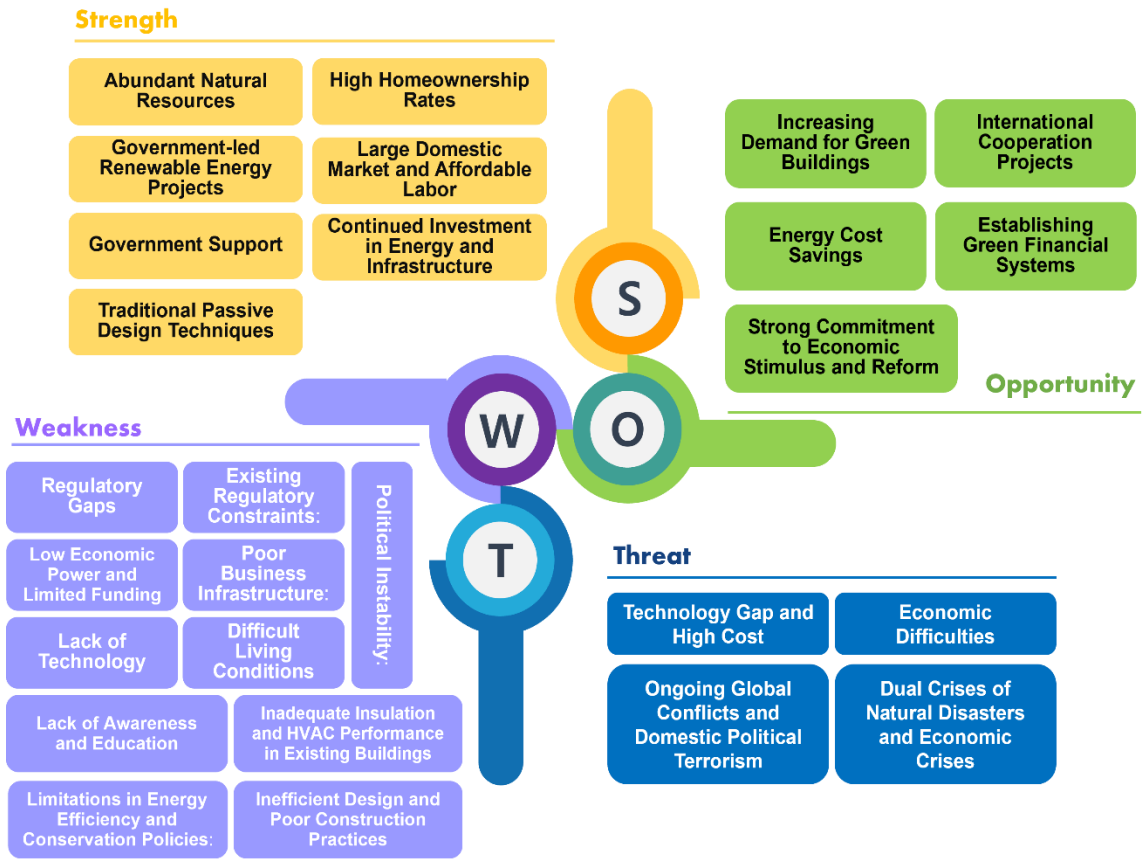
However, 17 out of 21 experts surveyed have no experience in green building-related projects and understand NDCs, but most of them have not participated in related briefings and research, so it is concluded that awareness of green building and NDC realization in Pakistan is just beginning and more research and briefings are needed.





3. SWOT Analysis and Strategy

In consideration of the aforementioned context, a SWOT analysis was conducted to establish a code, standards and practices, a design and rating system for the establishment of green building in Pakistan(Table 15).



Strengths	Weaknesses
• **Abundant natural resources**: Abundance of renewable energy resources such as solar for energy efficient construction • **Government-led renewable energy projects:** Solar and other renewable energy projects for energy independence • **Government support**: The government of Pakistan recognizes the urgency of reducing carbon emissions and the importance of sustainable development; the central and local governments provide support tailored to local contexts • **Traditional passive design techniques**: Pakistan's vernacular building techniques incorporate many passive design elements potentially applicable to green building	• **Regulatory gaps:** Lack of adequate regulations and standards tailored to Pakistan's diverse climatic and socio-economic conditions • **Low economic power and limited funding**: Sluggish economic growth means heavy initial burden for upfront investment in green building; limited investment and financing for related projects, especially from the private sector • **Lack of technology**: Difficulties in implementation due to lack of high-quality green building materials and technical professionals • **Political instability**: Political instability makes it difficult to pursue long-term policies • **Existing regulatory constraints**: Existing building codes primarily focus on the safety and amenities

• **High home ownership rates**: Over 90% of urban housing in Pakistan is owner-occupied, hence more acceptable to green building and easier to maintain • **Large domestic market and affordable labor**: Pakistan has a large domestic market and affordable labor, hence high growth potential for the green building market • **Continued investment in energy and infrastructure**: Continued investment in energy and infrastructure by governments and the private sector is expected to spur the adoption of green building	of buildings and lack regulations on energy efficiency • **Inefficient design and poor construction practices:** Disorganized urban planning and high population densities have resulted in many poorly designed, inefficient, and inhospitable buildings with poor quality of living • **Poor business infrastructure**: Poor business environment due to poor infrastructure such as power shortages • **Difficult living conditions**: Poor living conditions due to security, sanitation, and environmental issues • **Inadequate insulation and HAVZC performance in existing buildings:** Existing buildings are poorly insulated and have underperforming heating and cooling systems, hence low energy efficiency • **Limitations in energy efficiency and conservation policies**: Pakistan's energy efficiency and conservation policies are still centered around commercial buildings; lack of relevant policies in the housing sector despite the household sector being the major consumer of electricity in Pakistan • **Lack of awareness and education:** Lack of awareness of sustainable architecture among the building industry and the general public; lack of relevant education and training programs
Opportunities	**Threats**
• **Increasing demand for green buildings:** Growing awareness of environmental issues drives demand for green building • **Energy cost savings:** Energy-efficient construction leads to long-term energy cost savings • **Strong commitment to economic stimulus and reform:** Strong government stimulus and willingness for economic reform facilitate green building • **Establishing green financial systems**: Opportunities to lay the foundation for green financing such as green home mortgages, green commercial building loans, etc. • **International cooperation projects:** Opportunities for cooperation with international organizations to attract funding to develop local knowledge and resources and introduce advanced technologies	• **Economic difficulties**: Economic instability may hinder investment attraction in green building • **Technology gap and high cost**: Technology gap with advanced countries and inflation may slow the adoption of the latest green building technologies • **Ongoing global conflicts and domestic political terrorism**: Global conflicts and domestic political unrest continue to create security challenges • **Dual crises of natural disasters and economic crises**: Economic and industrial uncertainties due to the potential risk of climate change leading to natural disasters and economic crises

Table 15. SWOT Analysis for the Adoption of Green Building in Pakistan

Strategies for introducing green building in Pakistan were derived from the results of the SWOT analysis, as shown in Table 16. Among them, government-led campaigns to promote green building seem to be particularly effective in Pakistan. There is an urgent need to introduce a rating system and item-specific rating criteria through a performance rating system that is suitable for Pakistan's climatic conditions. Once the green building code is implemented, the effectiveness of the code and the performance rating system should be reviewed and improved by monitoring the performance of all green building projects. With this strategy, Pakistan will be able to effectively develop a green building certification system and establish relevant standards.

Element	Strategy	Details
SO (Strengths-Opportunities)	**Promote green building with government energy and infrastructure investment and renewable energy resources**	Organize projects and campaigns in conjunction with solar and other renewable energy projects that attract support and funding from international organizations and the Pakistani government to promote green building and improve energy efficiency; introduce a green building certification scheme for awareness building
	Establish customized green building standards	Develop customized green building standards taking into account the different climatic zones of Pakistan; effectively implement the green building certification scheme with support from international organizations
	Build the foundation for green finance	Establish green bond and other financial systems to encourage private investment and streamline project approval processes
WO (Weaknesses-Opportunities)	**Introduce green building materials and technical professionals**	Collaborate with international organizations to introduce green building materials and technical professionals to close the gap in the workforce and skills for green building
	Ease upfront investment costs	Facilitate the adoption of the green building certification scheme by reducing upfront investment costs through financial support from the government and international organizations
	Prevent inefficient design through the legal and institutional environment for green building	Establish a green building code and legal foundations for green building certification; develop an effective green building roadmap including the phased application to different building uses; develop and distribute detailed standards for building design, construction, operation and maintenance
ST (Strengths-Threats)	**Modernize traditional building techniques**	Modernize traditional building techniques to evolve them into Pakistan's own green building techniques in response to climate change and incorporate them into the green building certification scheme
	Leverage the huge domestic	Leverage the high home ownership rate and the large domestic market to drive the adoption of green building technologies and

	market to drive green building technology and certification scheme adoption	encourage participation in green building to promote the certification scheme
WT (Weaknesses-Threats)	**Improve energy efficiency and tackle economic challenges by harmonizing with existing building codes**	Ensure harmonization with the existing building codes to improve energy efficiency, provide practical measures to address economic challenges, and ensure the effectiveness of the green building certification scheme
	Overcome political instability and raise public awareness	Support the streamlined introduction of the green building certification scheme by strengthening collaboration with the private sector and raising public awareness
	Stimulate the construction market through a green building certification scheme	Improve the value of residential buildings through the green building certification scheme; provide the foundation for revitalizing the construction market through tax benefits and eased building area/height regulations, and other incentives

Table 16. Strategic Recommendations for the Adoption of Green Building in Pakistan Based on SWOT Analysis

V. Green Building Standards and Certification Schemes in Pakistan

1. Directions

Pakistan still lacks relevant institutions and frameworks for sustainable built environment such as green building. Given the sluggish progress of green building and the challenging environment and constraints in Pakistan, there is an urgent need for a government-led green building framework.

This chapter focuses on the development of green building evaluation criteria for Pakistan. To maintain consistency with international cooperation projects, the proposed framework[7] of Switch Asia, the MoCC's "*Vision 2030 for a Green Building Code in Pakistan*[28]" (Vision2030) and "*Policy Guidelines for Green Building Code*[1]" in 2022 were considered and incorporated into the new framework, taking into account the findings of previous studies and compatibility with the criteria. These previous studies have shown that the components of Green Building Certification (GBC) in Pakistan focus on design, construction and maintenance throughout the lifecycle of the building.

The phases elaborated under the Naya Pakistan Housing Program (NPHP) and proposed as part of the green building strategy have been further divided into: Landing, Site Planning, Construction Process Planning, Basic Design, Specifications, During Construction, and Post Construction(Figure 13). The key factors to be considered in these phases include energy, efficient water use, materials and systems, and waste management, which were considered for the development of the criteria.

7 A- SITE PLANNING & DEVELOPMENT, B - GREEN BUILDING CONSTRUCTION, C- RESOURCE EFFICIENCY, D - POST-COMPLETION GREEN BUILDING ACTIONS, E – GREEN BUILDING CODE COMPLIANCE & INFORMATIVE REFERENCES

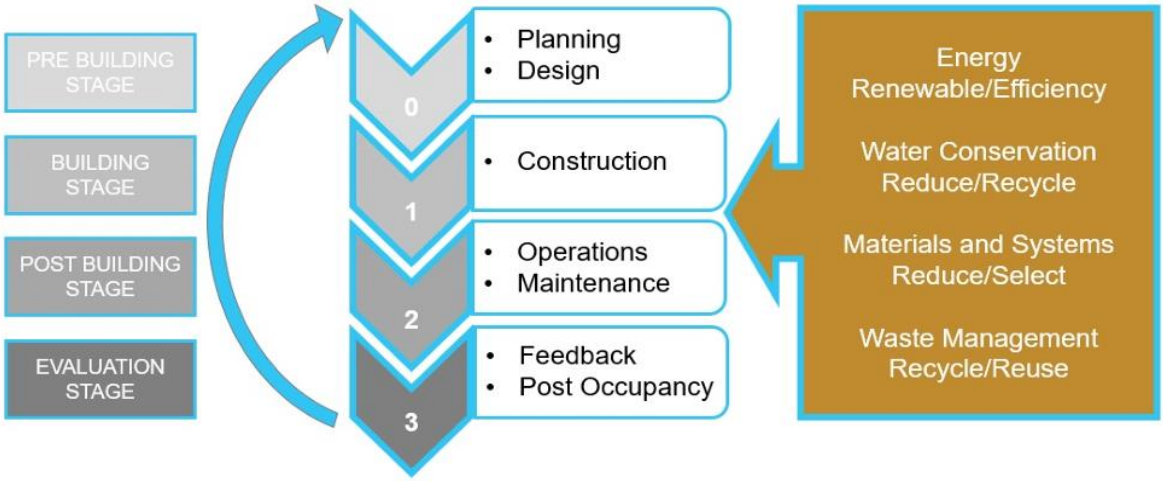


Figure 13. Stages of Impact Assessment of a Green Building Code from "Naya Pakistan Housing Programme (NPHP)[30]"

Switchasia's Vision 2030 report[28] specifically identifies heat island effect, urban flooding, water scarcity, and earthquakes as vulnerabilities that require special attention in the Pakistan Green Building Code, and suggests responses to them, as shown in Table 17. For earthquake preparedness, the detailed criteria can be updated in conjunction with the earthquake-related provisions of the Pakistan Building Code, while measures to address heat island effect, urban flooding and water scarcity were considered in the development of the framework for the detailed criteria presented here.

Vulnerability	Possible Countermeasures
Extreme heat (Increasing Energy Consumption/Demands)	Energy, Renewable/ Efficiency Materials and Systems, Reduce/Select
Urban Flooding	Waste Management, Recycle/Reuse Water Conservation Materials and Systems Need for integration or linkage with existing relevant regulations
Water Scarcity	Water Conservation, Reduce/Recycle
Earthquake	- Materials and Systems, Reduce/Select - Need for integration or linkage with existing relevant regulations

Table 17. Vulnerable environmental factors in Pakistan and green building mitigation strategies[28]

Suggested Components of the GBC in "Vision 2030 for a Green Building Code in Pakistan"	
Overview	Executive Summary
	General Provisions
	Green Building Strategies
A- Site Planning & Development	Site Sustainability
	Building Orientation
	Heat Island Mitigation
	Green Planning and Design
	Effective Land and Space Use
B- Green Building Construction	Building Materials Sustainability
	Building Envelope and Openings
	Natural and Controlled Ventilation
	Fire Safety
	Roof Insulation
C- Resource Efficiency	Water Efficiency
	Rainwater Harvesting
	Energy Efficiency
	Solid and Liquid Wastes Management
D- Post-Completion Green Building Actions	Environmental Pre-requisites and Assessment
	Building Inspection & Commissioning
	Green Building Code Compliance Rating
	Post-Occupation O&M Considerations
Green Building Code Compliance & Informative References	References (to be Annexed or Quoted)

Proposed Components of the GBC Standards by KICT and KRIEA	
A- Site Planning & Development	A.1 Ecological value of existing land
	A. 2 Minimizing soil cut/fill in earthwork
	A.3 Validity of measures to prevent natural light interference
	A.4 Heat wave response and heat island effect mitigation plan
	A.5 Building connected green space axes
	A.6 Ecological area ratio
	A. 7 Accessibility to public transport and amenities
B- ENERGY & ENVIRONMENTAL POLLUTION	B.1 Building Envelop & Opening
	B.2 Prohibition of specific materials to protect ozone layers
	B.3 Use of renewable energy sources
	B.4 Lighting energy saving (non-residential)
C- Resource Efficiency	C.1 Building Material Substantiality
	C.2 Water Efficiency
	C.3 Rainwater Management
	C.4 Solid & Liquid Wastes Management
D-INDOOR ENVIRONMENTAL QUALITY	D. 1Use of low indoor air pollutant discharging materials
	D.2 Tobacco Smoke Control
	D.3 Natural lighting (residential buildings) (주거용 건축물)
	D.4 Resting and refreshing area
	D.5 Natural & Controlled ventilation
E. POST-COMPLETION GREEN BUILDING ACTIONS	E.1 Environmentally-friendly space planning and management
	E.2 Construction site environment management
	E3. Operation and maintenance
	E4. Monitoring

Figure 14. Switch-Asia's Proposed Top-level Structure and Sub-components for Pakistan GBC (Left [28]) and the Revised Proposed Structure (Right) from this Study

Based on the literature review of previous studies, a standard framework for the Pakistan GBC has been developed in consideration of areas of need for Pakistan, policy feasibility and effectiveness, residents' health requirements, and environmental conservation, as shown in Figure 14. In this process, part of the broad sub-component topics was regrouped, consolidated or elaborated, and more specific topics were developed to elaborate actionable items to achieve environmental and human sustainability.

Pakistan's current building regulatory system is primarily prescriptive or elemental specification-based. It is centered around codes and standards that require buildings be designed, constructed, protected, and maintained for public safety and convenience. While an approach that specifies both code requirements and measures to meet them may be appropriate for a prescriptive-based system, such as Pakistan's building code, earthquake code, fire safety code, and energy efficiency code, it may not fit a performance-based system[28]. Thus, for the effective implementation of the green building code and rating system, it is suggested that local governments introduce their own versions of PGBC with

reference to a performance-based system based on the organizational structure shown in Figure 14.

In particular, the structure presented in this study emphasizes environmental sustainability through the sub-criteria items, i.e., prohibiting the use of certain ozone-depleting substances and the use of renewable energy sources to fight climate change. In addition, "building envelope and openings" and "sustainability of building materials" were consolidated as "energy" items for the efficiency and practicality of building envelope design and simplification of the system. It also includes items for indoor environmental quality and residents' health. The functional objectives and performance requirements of the new green building code and rating system reflect society's expectations for building safety and health.

2. Implementation and Operation Strategy of Pakistan's Green Building Code and Certification System

■ Plan to Introduce a Government-led Green Building Rating System

In 2018, residential construction projects led by the private sector increased sharply, accounting for 35% of the total construction market[32], leading to expectations of an increase in the share of residential construction. Nevertheless, the low penetration of green buildings and the lack of relevant material markets and professionals remain challenges to the diffusion of low-carbon buildings. In Korea, a government-led green building rating system has been established under the Green Building Construction Support Act, which has led to the rapid development of a related industry ecosystem. In addition, the establishment of green building and the development of evaluation criteria have raised public awareness. This positive aspect can also work for Pakistan to adopt green building, and the development of a government-led green building rating system would lead to the establishment of an industrial base and public awareness. Figure 15 shows the progressive development of the rating system.

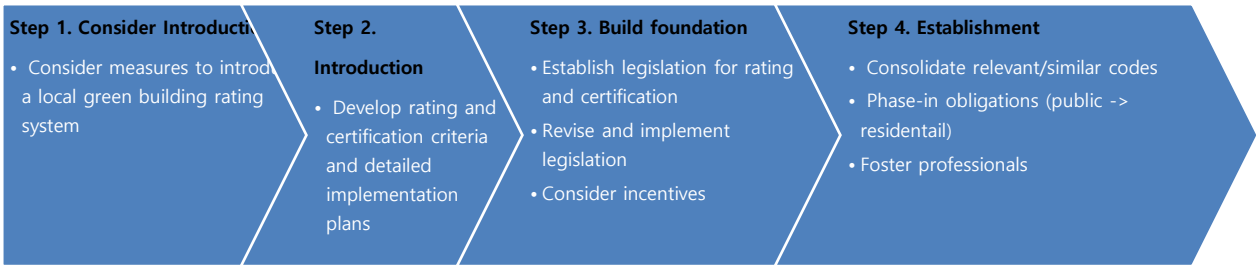


Figure 15. Gradual Implementation Plan for the Establishment of Green Building Regulations in Pakistan

■ Green Building Code Framework

In general, the PGBC will follow the steps shown in Table 18, starting with the formation of a task force and technical committees, followed by data collection, drafting, feedback, and finalization and approval.

Phase	Agency	Action	Description
1	MoCC	Mobilize a task force and technical committees	Organize a task force chaired by the federal minister for climate change; technical committees start working on the GBC; assess and identify zoning policies, building codes, obstacles, etc.; analyze environmental hotspots and resource tradeoffs
2	MoCC	Collect and compile criteria	Collect, organize, and compile topic-specific criteria based on preliminary reports from technical committees; criteria should be expressed both in quantitative and qualitative terms
3	MoCC	Circulate a draft GBC	Circulate the draft GBC to key stakeholders; reach an agreement on proposed sections, provisions, criteria, etc.
4	MoCC	Review the draft and collect feedback	The task force reviews comments and observations on the draft GBC and submits them to the MoCC; formal validation process
5	MoCC	Finalize and legally approve the GBC	Finalize the green building code; approval from relevant agencies; review by the Ministry of Justice for nationwide enforcement; seismic design, energy, and fire safety codes remain as separate regulations

Table 18. Preparatory Stage for Pakistan Green Building Council (GBC) as Proposed by Switch-Asia [28]

As shown in Table 19, the PGBC will cover the purpose of green building, basic planning, building energy management, green building certification, and training of green building professionals. The code will also serve as a legal basis for the review of the national green building masterplan every five years, consideration of performance and the roadmap, the implementation of the certification scheme, and the designation of an organization dedicated to green building.

Category	Details
Chapter 1. General Provisions	Purpose, definitions, basic principles, etc.
Chapter 2. Green Building Masterplan, etc.	Establish a green building masterplan every five years
Chapter 3. Building Energy and Greenhouse Gas Management	Establish a GHG emissions and energy consumption information system Manage the total energy consumption of buildings by region Limit the total energy consumption of individual buildings Improve the energy performance of existing buildings Submit energy conservation plans
Chapter 4. Green Building Rating System	Green building certification system
Chapter 5. Green Building Practice and Support	Foster professionals in green building Designate a green building center

Table 19. Establishing of legal framework for the Pakistan Green Building Code

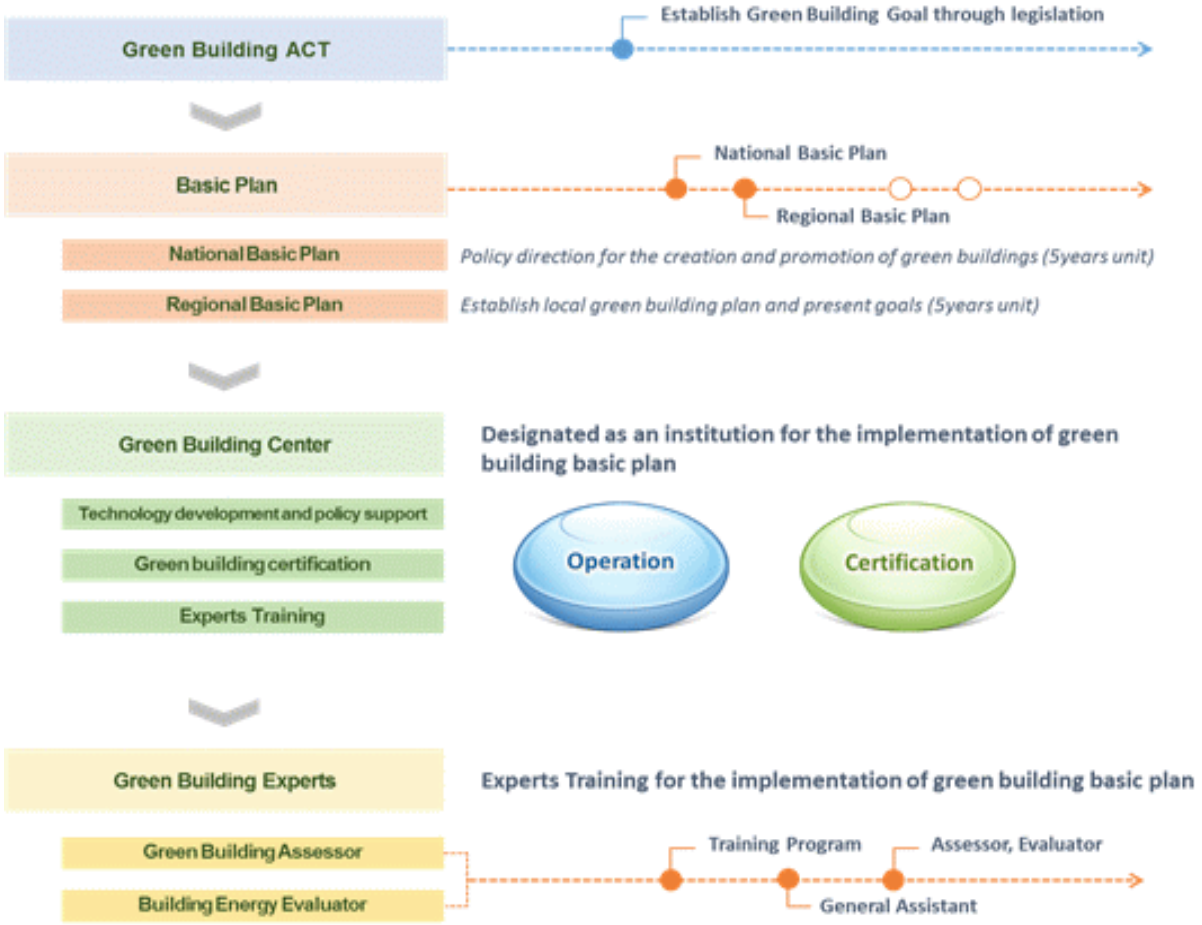


Figure 16. Legal and Institutional Framework for the Promotion of Green Building

Figure 16 is a conceptual illustration of the legal and institutional framework for achieving the green building targets. The top section shows the process of setting green building targets under the Green Building ACT, and below that are two basic plans (National Basic Plan and Regional Basic Plan). These plans are used to set policy directions and targets for the creation and promotion of green buildings at the national and local levels every five years. The GBC and subsequent building regulations, reference standards, and ordinances can be amended, revised, or repealed (if necessary) through the five-year review and update process. This allows new construction methods and technologies to be incorporated into the code, including those for residential and non-residential buildings in both urban and rural areas. In addition, for the first five years after promulgation, the GBC will cover certain types of buildings (e.g., residential and apartment buildings with at least three stories, excluding single/double-family dwellings) and then gradually expand the scope every five years. In applying these regulations, it will be necessary to monitor and respond flexibly to market and economic conditions.

The middle part of the figure describes the introduction of the "Green Building Center" for the implementation of the Green Building Basic Plans. The center will be responsible for technological development, policy support, green building certification, and professional training.

The bottom part explains the progression to "Green Building Experts" in two professional streams: Green Building Assessors and Building Energy Evaluators. These professionals will receive training for the implementation of the Green Building Basic Plans. The figure shows pathways for expert, evaluator, and assessor training and for general assistants, indicating how these professionals will be trained and placed in relevant positions. The two ovals on the right, "Operation" and "Certification", respectively symbolize the operation of the green building center and the certification process.

- **Example of Organizational Structure and Operational Mechanisms for the Green Building Certification System**

The organizational structure for the operation of the green building code and rating system consists of a government organization, an operating agency, and an authentication agency. Figure 17 illustrates an example of the green building certification process from application to certification with the roles of each organization and the relationship between them. The

roles of relevant organizations in Pakistan have been identified based on the GBC organizational structure section[28] of "Vision 2030 for a Green Building Code in Pakistan".

- **Government organization**: The highest governing body with the legal authority to designate the management organization and designate/accredit the certification body. In Pakistan, this structure should be designed taking into account the relationship and authority between the central government (Ministry of Climate Change, Ministry of Housing & Works) and the federal government (green building divisions or authorities having jurisdiction (AHJs)).
- **Operating agency**: Responsible for operating the certification management system, reviewing certification results, facilitating green building certification, providing training and consultation services, developing the certification system, and promoting related initiatives. This may be the Pakistan Green Building Council (PGBC) or a separate organization designated under the GBC.
- **Building owners**: Apply for green building certification and receive certificates
- **Authentication agency**: Responsible for conducting document reviews and on-site inspections and preparing reports. This may be the Pakistan Green Building Council (PGBC) or a separate organization designated under the GBC. The authentication agency should have technical experts (professional assessors) to communicate directly with the building owner or applicant, verify the applicability of the regulations and review the documentation. Their expertise and integrity should be assured for the fair operation of the system.
- **Deliberative committee (third party review)**: A group of experts in various fields to review the reports and determine assessment results (e.g., architects, engineers, community representatives, etc.)
- **Certification operating committee**: Responsible for reviewing the green building certification criteria and making decisions on system improvements. May be affiliated with the Pakistan Engineering Council (PEC), the Pakistan Council of Architects and Town Planners (PCATP), etc.

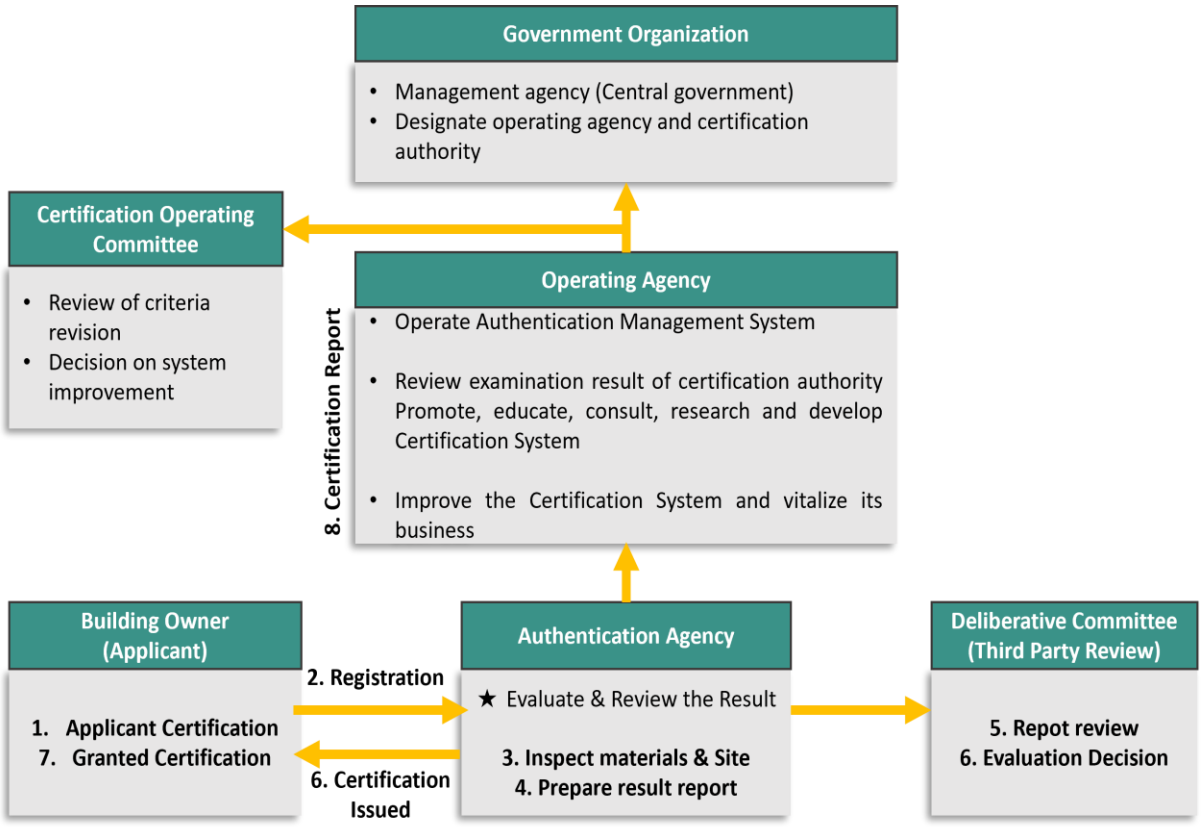


Figure 17. Green Building Certification System and Certification Process (Example)

■ Roles and Importance of the Operating Agency (tentatively named "Green Building Center)

The operating agency (Green Building Center) plays an important role in maintaining and developing the green building certification system. It is responsible for operating the certification management system, reviewing the evaluation results of the certification body, promoting the certification system, training, consulting, investigation, research and development, improving and revitalizing the certification system, training, managing and supervising professional evaluators, and analyzing and utilizing certification statistics, etc. It may also serve as a certification body in the early stages of the program.

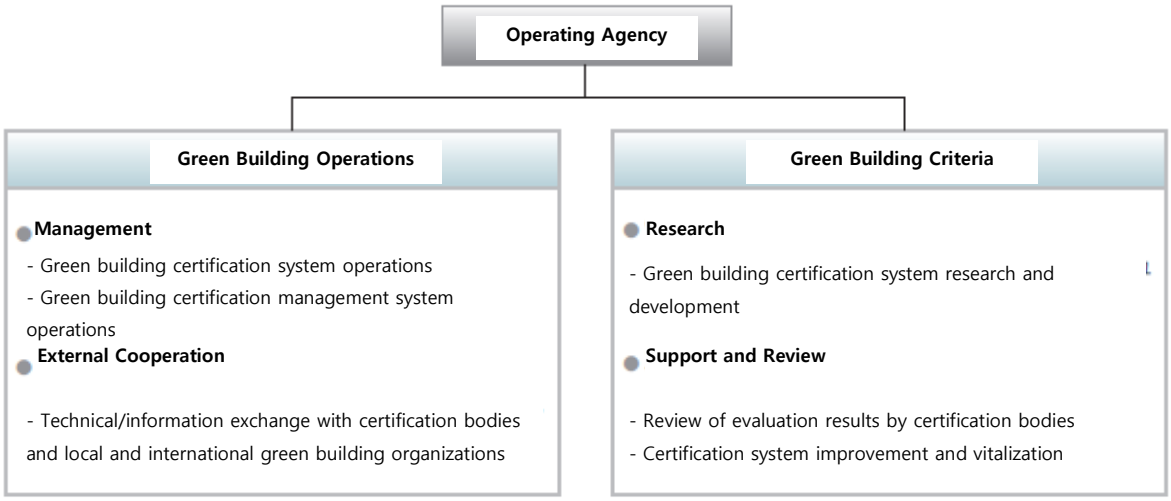


Figure 18. Organizational Structure by Function for Green Building Operating Agencies

The Green Building Center assigns dedicated certification system operating personnel at the Green Building Operation Center to perform practical tasks related to the operation of the system. Below is the anticipated organizational structure of the Green Building Center.

- Director
- Staff dedicated to system operation
- Staff dedicated to criteria
- Staff dedicated to administrative support

The Green Building Center may consist of the following teams:

- Green Building Operations Team: Responsible for policy and program marketing, certification data management, global networking, administrative support, and training management
- Green Building Criteria Team: Responsible for the development and support of certification criteria and training of certification evaluators

It may also have the following committees:

- Criteria Committee: Professionals responsible for establishing and revising technical criteria for the certification system

- Operating Committee: Professionals responsible for the overall certification system operations

With this structure and role, the Green Building Center will be able to effectively support the operation and development of the green building certification system in Pakistan.

■ Green Building Center's Roles

System operations	- Operate sectoral committees and subcommittees, including the Deliberative Committee - Interpret certification criteria, operate a certification result appeal system, and verify evaluation results - Present mid/long-term policy directions for green buildings and provide institutional support (seminars, discussions, etc. for system development) - Support networking with government departments, certification bodies, and educational institutions (regular meetings, workshops, meetings, etc.)
Certification criteria development and other research activities	- Develop certification criteria and regularly review and revise them - Produce and disseminate detailed guidelines for certification and organize education and training workshops for certification bodies - Provide lectures, symposiums and other education to relevant industries such as design and construction - Conduct research to build a foundation for green building certification criteria
Information system development	- Establish databases of information system and certification performance, evaluation results, etc. - Provide certification-related information such as statistical data on certification applications and results - Follow-up management of certification information and certified buildings
External cooperation	- Operate external channels to monitor, evaluate, improve, and supplement green policies and systems - Establish a cooperation system with overseas organizations related to green buildings and support international networking for branding and promotion of the system

Table 20. Examples of the typical scope of work to be undertaken when designated as a Green Building Center

The Green Building Center can play a pivotal role in the adoption and promotion of green building aimed at reducing emissions and achieving energy efficiency. Table 20 shows the general scope of work of the Green Building Center.

■ Phased Plans for Implementing a Green Building Certification System

Establishing a green building policy and system requires a phased approach to planning and implementation, as shown in Table 21. The first step is to prepare the certification system and lay the groundwork for green building certification. During this phase, goals are defined, strategies are established, a certification process is developed, green building criteria are established, and the legal basis for green building certification is established based on a mid- to long-term roadmap. It also includes research, effectiveness analysis, initial testing, pilot projects, and the establishment of a mid- to long-term roadmap for green building policy development.

The second phase, "System Implementation," is where the developed certification criteria and methodologies are demonstrated in real-world settings. With a particular focus on the certification process, it validates the developed rating system and verifies its compliance with the green building criteria.

In the third phase, the developed certification criteria and system are be revitalized and promoted. Efforts are made to disseminate proven green building criteria and methodologies, introduce proven new technologies throughout the industry, and raise public awareness. This is an important process for establishing sustainable building standards and raising public awareness of green building.

Phase 1 (Preparation): Designate an operating agency and elaborate its roles	Designate the operating agency; develop business guidelines and manuals Establish a certification process Establish a detailed roadmap for the operation of the operating agency Review certification criteria and processes through pilot projects Establish certification evaluator training and registration system Establish a certification business system
Phase 2 (Implementation): Operate the system and conduct certification services	Establish certification criteria and implement certification for public buildings Establish certification result verification procedures Acquire certification result data
Phase 3 (Vitalization): Establish certification operations and conduct certification services	Revise certification criteria based on review of certification performance Implement certification for large buildings Develop training programs for the general public Consider measures to vitalize the certification system

Table 21. Phased plan for implementing the green building certification system

3. Overview of the Pakistan Green Building Certification (PGBC)

■ Objectives of the Green Building Rating System in Pakistan

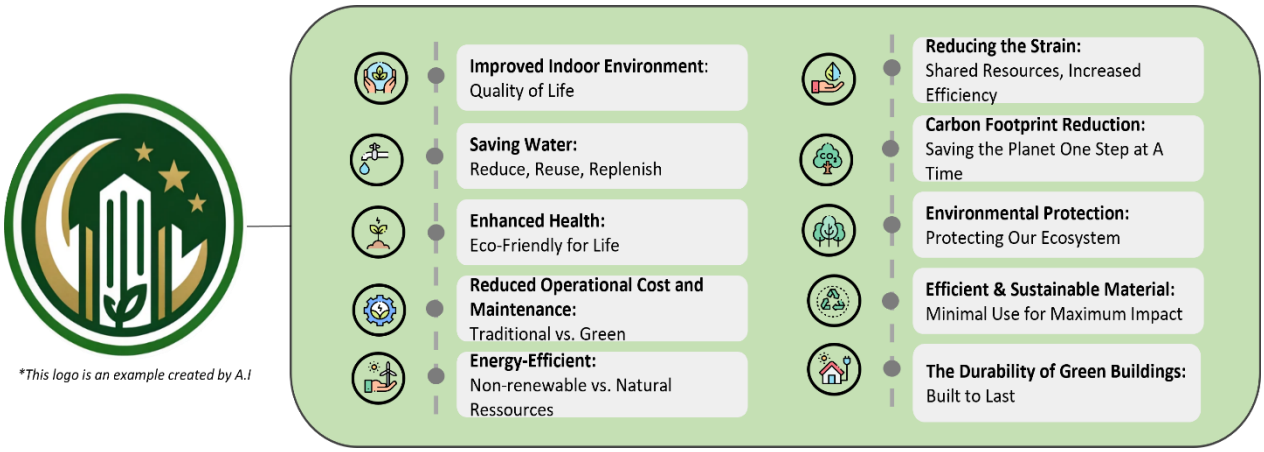


Figure 19. Aim of the Pakistan Green Building

The Pakistan Green Building Certification (PGBC) aims to promote green building practices that fit Pakistan's climate conditions and contribute to energy saving and pollution mitigation by assessing the impact on the environment and residents throughout the building lifecycle, from materials and design to construction, maintenance, and disposal.

Figure 19 describes the key benefits of green building in addressing Pakistan's current issues and specific goals for improving the environment and quality of life for residents.

- **Improved indoor environment**: Aim to improve the quality of life for residents; this can be achieved by improved indoor air quality, increased natural light, and pleasant climate control.
- **Saving water**: An important element for resource protection; measures to reduce water consumption, reuse water, and replenish natural water resources; this contributes to addressing water scarcity issues and achieving sustainable living.
- **Enhanced health:** Enhance the health of occupants by reducing harmful substances discharged from buildings, using green materials, and providing a nature-friendly living environment.

- **Reduced operational cost and maintenance:** Discover and develop cost-effective technologies and design options between traditional and green building methods to reduce long-term costs.
- **Energy efficiency:** Use natural resources and passive design to save energy and improve building efficiency.
- **Reducing the strain:** Achieved through resource sharing and increased efficiency; aim to optimize the use of shared resources and reduce the environmental strain through efficient resource management.
- **Carbon footprint reduction:** Everyday practices to save the planet; reduce carbon emissions in the building process and promote sustainable lifestyles.
- **Environmental protection**: Protect natural environments and ecosystems through waste management and pollution prevention
- **Efficient and sustainable material**: Select the least expensive and most sustainable materials to achieve the maximum benefit; encourage the use of high-efficiency materials and recyclable materials.
- **Durability of green buildings**: Encourage building designs that last longer.

By achieving these detailed goals for green building, Pakistan will be able to protect the environment, improve the quality of life for residents, and improve the energy efficiency and insulation performance of buildings.

■ Green Building Dissemination Roadmap and Buildings Subject to Certification

To create a foundation for green building in Pakistan, the following application and diffusion strategies can be employed.

- **Strategy 1. Phased green building policy application**: Target buildings can be classified and prioritized by size and use, or by mandatory and voluntary certification. The size and scope of the targets can be gradually expanded as green building becomes industrialized.
  - Example 1) Mandatory certification: Public buildings with a gross floor area of 3,000 m2 or more

- Example 2) Multi-household (residential) buildings with 300+ units

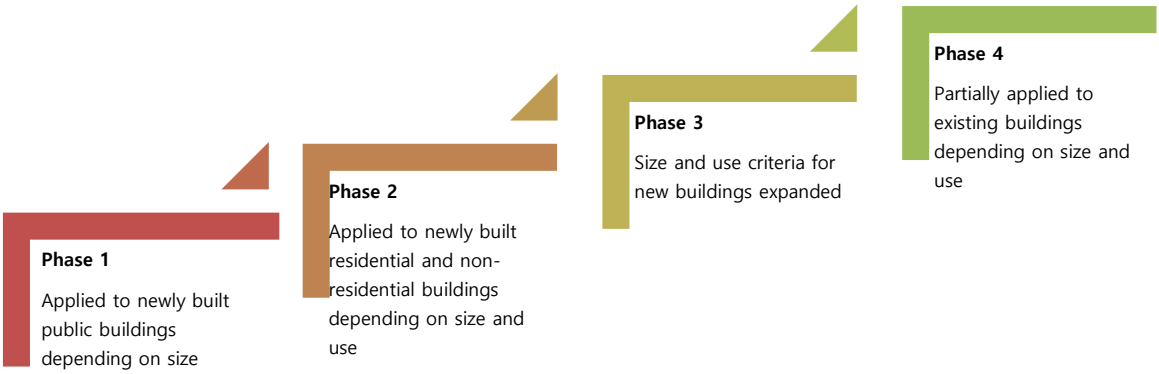


Figure 20. Phased application and expansion of green building (example)

Figure 20 shows an example of a phased approach to the application and expansion of green building. In the first phase, the certification system requires new construction projects by public institutions to obtain mandatory certification and strongly encourages other buildings to be certified as well. It also encourages the expansion of relevant markets and the development of professional human resources. In the second phase, new buildings will be subject to mandatory certification based on their size and use, and the application of the system will be encouraged through incentive programs. In the third phase, stricter criteria will be applied to the buildings subject to mandatory certification in the previous phase, and the certification system will be further extended to buildings with other uses. Finally, in the fourth phase, some stricter criteria will be applied to new buildings, and the requirements for existing buildings will gradually move from voluntary to mandatory certification for long-term development. This long-term roadmap should be monitored from time to time, and the direction and scope may be revised during the five-year review process. Mandatory requirements should be addressed in the Green Building Code, certification standards, and other building codes.

- **Strategy 2**. **Enabling policies for the voluntary acceptance of the green building certification system**: Another strategy is to encourage voluntary use of the certification system by providing a range of economic support and incentive programs based on analysis of existing systems and case studies (e.g. tax incentives, financial support, low interest loans, easing building requirements, etc.).

It is recommended that Pakistan's Green Building Code specify buildings subject to the green building certification system. It should encompass all buildings, with exclusions for military installations and other structures for which the system is inapplicable. Buildings are broadly divided into new buildings and buildings in use (Figure 21, Figure 22). These categories can be further subdivided into residential and non-residential buildings. Residential buildings are typically categorized into multi-household, regular, and standalone houses. However, a re-categorization of buildings in Pakistan seems essential. Non-residential buildings are those not used for residential purposes. These can be sub-categorised into commercial and office buildings, or into schools and other facilities as the industrialization of green building progresses. Buildings used for two or more purposes, which may consist of one or multiple wings, can also be evaluated as a separate category of complex building.

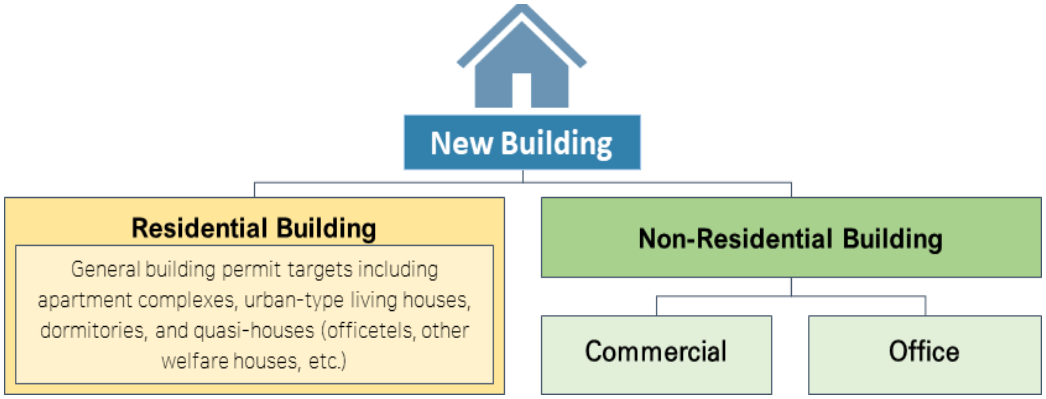


Figure 21. Pakistan Green Building Certification Target Classification – New building

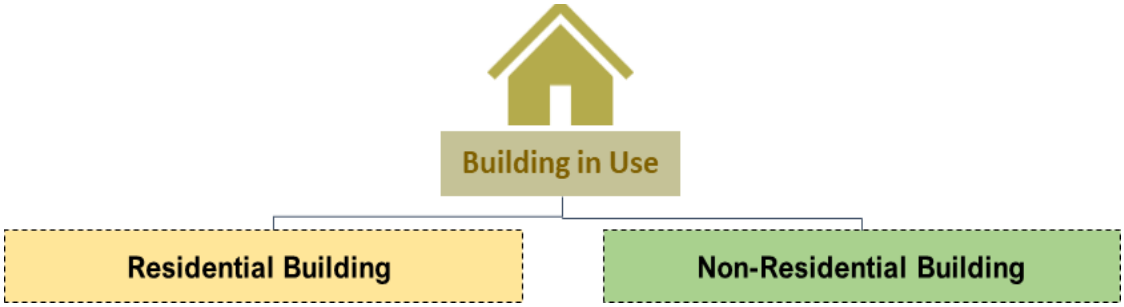


Figure 22. Pakistan Green Building Certification Target Classification – Building in Use

However, given that Pakistan is still in the early stages of introducing green buildings, the rating system needs to be simplified. The rating system considered in this study is based on green building criteria for new residential and non-residential buildings. As the green

building industry and expertise develops, the criteria can be gradually expanded to cover a wider range of scales and uses, as shown in Figure 20.

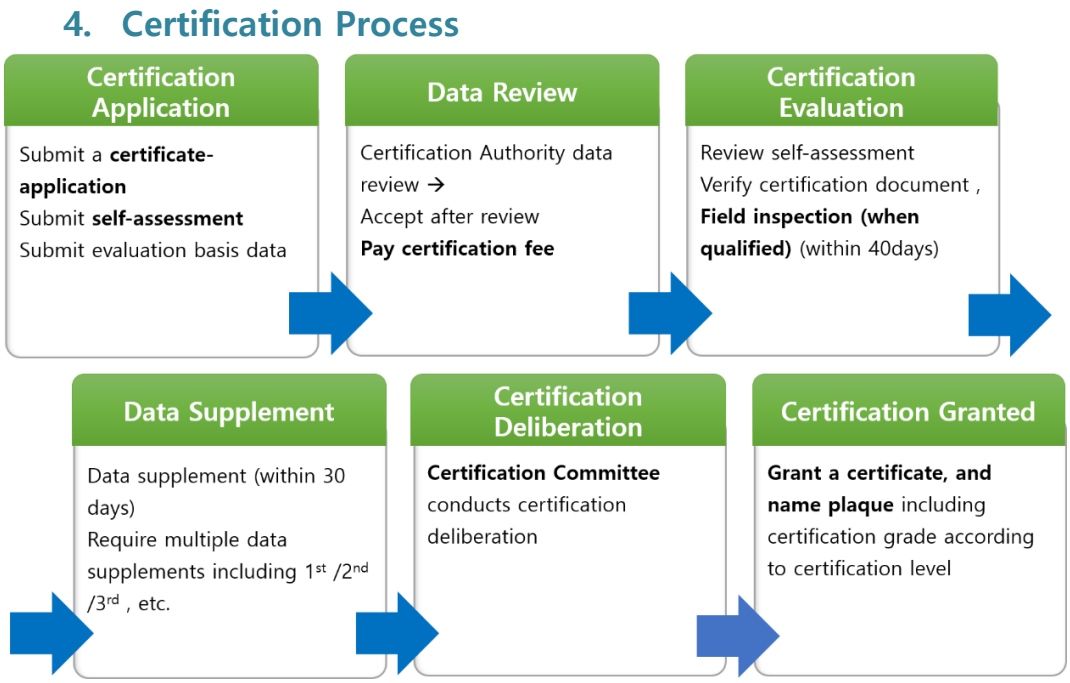


Figure 23. Green Building Certification Procedure (Example)

The PGBC will be a voluntary certification system, administered by an organization designated by the government. The certification system will comprise six processes, as shown in Figure 23. These processes outline the steps to obtain certification for a building or system that meets the green building criteria. The initial step is the submission of an application for certification. This entails the provision of all necessary documentation and self-assessment results by the applicant seeking certification. The next step is for the certification body to review the submitted documentation and for the applicant to pay the applicable certification fees. Additional information may be requested at any stage of the process. A key aspect of the certification process is the deliberation conducted by the Deliberative Committee, which provides input for the final certification decision. In the certification evaluation phase, the documentation and the results of the on-site inspection are reviewed to determine whether to grant certification. For new buildings, the pre-certification evaluation may entail a review of drawings, specifications, and system performance data to ascertain whether PGBC requirements are met in all building plans prior to construction. This is followed by the implementation phase to guarantee

compliance with the identified pre-certification requirements. Upon certification, a certificate and plaque for the applicable rating are awarded.

The process is designed to guarantee transparency and consistency, offering formal acknowledgment that the building meets the defined quantitative and qualitative performance criteria for green building. The process is intended to standardize the certification process and serve as a resource for stakeholders, providing clarity on the expectations and documentation required for each stage.

5. Rating Standards

There are four green building ratings granted based on the score achieved in the certification evaluation (Best, Excellent, Good, and Standard). Different criteria may be applied to new and existing buildings as shown in Table 22.

Category		Best (Green Level 1)	Excellent (Green Level 2)	Good (Green Level 3)	Standard (Green Level 4)
New	Residential	74 or higher	66 or higher	58 or higher	50 or higher
	Non-residential	80 or higher	70 or higher	60 or higher	50 or higher
Existing	Residential	69 or higher	61 or higher	53 or higher	45 or higher
	Non-residential	75 or higher	65 or higher	55 or higher	45 or higher

Table 22. Score criteria by certification level (example)

6. Green Building Certification Fees and Validity

- Green building certification operations encompass a range of activities. It is essential to estimate certification fees in consideration of the work involved and the activities required to operate the system. These fees consist of the labor costs of professionals who review the design plans and related documents, as well as the costs associated with on-site inspections and other necessary activities.

- A green building certificate is valid for a period of five years from the date of issuance. Buildings that have obtained green building certification may request an extension, which must be submitted no earlier than 180 days before expiry and

no later than the expiration date. The validity of the certificate may be extended only once for up to five years.

7. Incentives and Financial Support for Green Building Certification

Incentive systems are designed to promote the adoption of green building practices among architects and building owners by offering economic benefits (such as tax exemptions) or easing the requirements for buildings that have obtained green certification. Local governments should develop policies and incentive models that align with their specific circumstances, consider existing incentives, expected outcomes, feasibility, and more.

- Promoting and vitalizing green building practices by providing various incentives for buildings that have obtained green building certification and developing economic support models for green building construction.

- Examples of incentives

Incentive (example)	Description
Tax exemptions or reductions	Monetary benefits for taxes related to the construction and acquisition of the building (property tax, acquisition tax, etc.)
Relaxation of building standards	Allowing for higher floor area ratios, higher building heights, etc.
Financial and institutional incentives for green building-certified contractors	- Extra credit for participation in state-owned building projects - Relaxation of gratuitous donation requirements for housing construction projects ...

Table 23. Example of incentives related to green building certification

VI. PGBC's Assessment Structure and Criteria

In this chapter, the PGBC's assessment structure is defined and detailed criteria are discussed.

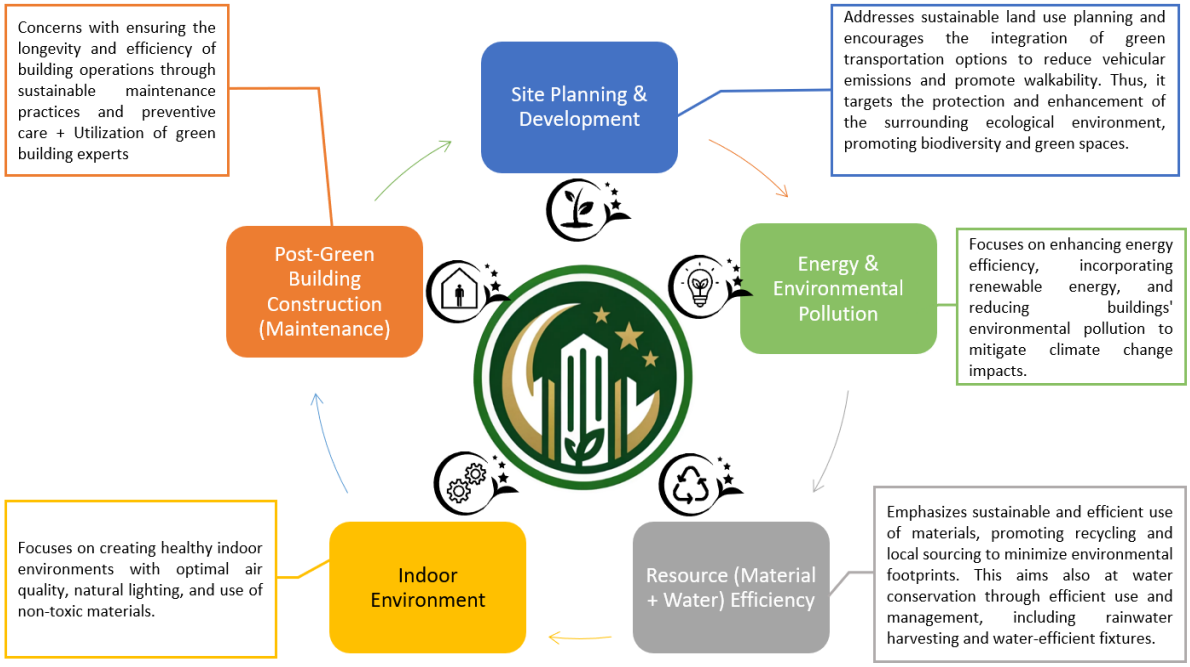
The assessment structure has been re-configured in considered of Pakistan's circumstances, and detailed assessment criteria with clearly defined quantitative standards to measure building performance have been developed.

1. Pakistan Green Building Code Structure

Based on the analysis results and strategies discussed in Chapter II, five areas of green building assessment in Pakistan (land use and transportation, ecological environment, energy and environmental pollution, materials, resources and water cycle management, indoor environment, and maintenance) have been developed as shown in Table 24. The details of item-specific calculation criteria are presented in Appendix 5.

As previously noted in studies, the GBC should address several key areas, including area development and land use, building energy efficiency, green building safety, fire safety, water efficiency and grey water disposal, energy efficiency, gas supply, indoor air quality and comfort, material resource conservation and waste management, and more. It should be noted that the Earthquake Provisions (SPBC, 2007) and the Fire Safety Provisions (FSPBC, 2017) are closely associated with Fire Safety and Seismic Safety Design Standards. These should be taken into consideration in line with the detailed assessment items presented herein.

Pakistan Green Building Certification 2024



Area	Assessment
A. Site Planning & Development	Consider relevance to the external environment in terms of conserving or restoring the ecological functions of the land to the greatest extent possible; minimize the direct impact of the development process on the diversity of species to ensure the biota of the habitat.
B. Energy & Environmental Pollution	Evaluate architectural and system-level measures for energy consumed to building operations
C. Resource Efficiency	Assess the use and input of low-carbon materials and resource-cycling materials that contribute to reducing environmental pollution and impact in consideration of the impact of materials throughout the building process
	Assess rainwater management and utilization methods for conserving water and pursuing an efficient water cycle
D. Indoor Environmental Quality	Assess the thermal, acoustic, light, and air environments by considering aspects related to minimizing harm to occupants' and neighbors' health and wellbeing
E. Post-Completion Green Building Actions	Assess architectural methods to minimize and maximize environmental impact through proper maintenance

Table 24. Description of the PGBC's categories

Figure 24 shows the percentage of points for each item included in the Pakistan Green Building Assessment, with a total score of 100. Section B, Energy and Environmental Pollution, accounts for the largest portion in the scoring system, followed by Section D, Indoor Environmental Quality, and Section C, Resource Efficiency, Section A, Site Planning and Development, and Section E, Post-Completion Green Building Actions.

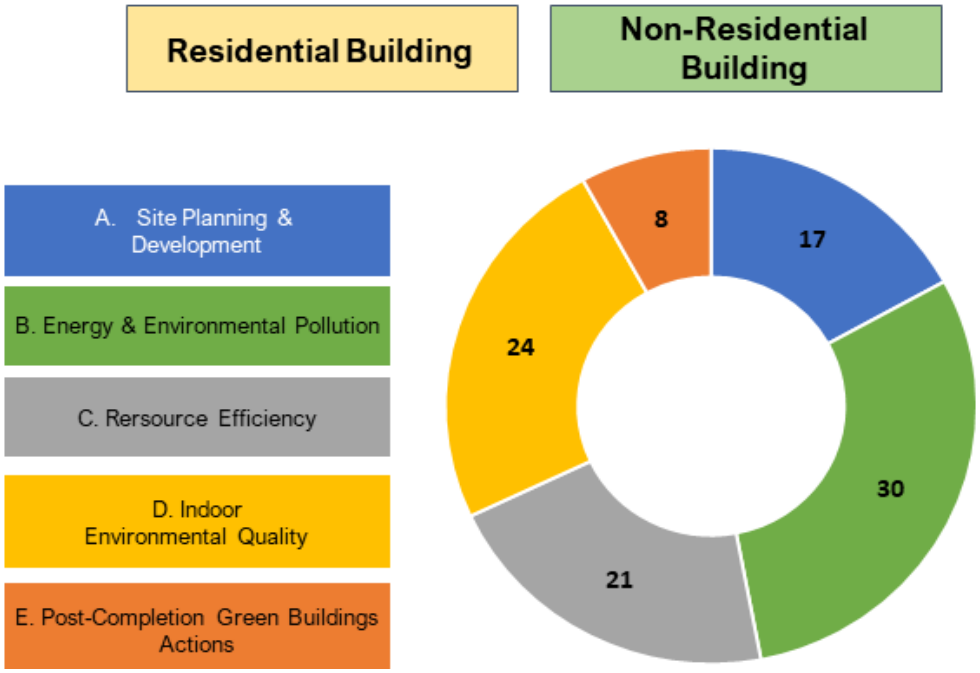


Figure 24. Weighting of the criteria of PGB2024 Certification'

2. Criteria

These six aspects of the PGBC will be applied to new buildings in a pilot project. They entail detailed evaluation criteria and metrics as summarized in Figure 25. Area-specific criteria are shown in Appendix 4.

① **Header Section and Classification:** Indicates the title of the rating system with the Pakistan Green Building Certification logo; specifies the applicable area of the Pakistani standards and detailed assessment item, as well as the score and area-specific mandatory requirements/evaluation/additional points applied. Given that the green building infrastructure still remains in infancy in Pakistan, mandatory and additional points elements have been excluded from the assessment structure presented in this study.

② **Objective & Evaluation Method**: Describes the purpose of the criteria and ways to meet them; contains iconized illustration of their relevance to the UN SDGs.

③ **Detailed Evaluation Criteria:** Provides a set of qualitative and quantitative metrics and sub-metrics for evaluation; assigns scores and weight based on the type and grade; determines a rating by adding up and/or multiplying numbers and scores.

④ **References, Submission Documents:** Lists documents that have been referenced for the metrics and sub-metrics. These documents primarily consist of regulations, laws, policies, strategies, standards, and other materials provided by governments and international organizations. The literature referenced in this study is for illustrative purposes and consists of sources from Korea and other countries. It should be updated with equivalent or similar Pakistani sources.

These components are intended organize the structure and content of the green building certification process to ensure well-structured evaluations.

Pakistan Green Building Code & Certification 2024				
Category				
Certification Items		Points		Evaluation Items
Objective & Evaluation Method				
Evaluation Purpose				
SDGs				
Assessment Methods				
Detailed Evaluation Criteria				
Grade				
Evaluation Scope				
Evaluation standard				
References				
Submission Document				

Figure 25. Sample of the PGBC standard format

VII. Development of Education Materials

In addition to the G-SEED and element technology list that we would like to suggest to Pakistan, we developed education materials for green building capacity enhancement educational programs that Pakistan's experts and locals can use for their own education as the third achievement of this project

The education materials for educational programs that will be provided as the final outcome of this Pakistan project can help Pakistani locals and experts strengthen their green building capabilities by summarizing theories and case studies on green building elements.

This project found out that Pakistan has a rather low public awareness of green buildings. Therefore, this educational program was created for experts in the Pakistan green building sector as well as the general public who are pursuing development in the field.

The table below shows the table of contents for the educational program for strengthening human capacity for green buildings in Pakistan. Starting with a theoretical approach to the overview of green buildings, it contains theoretical content on cases of green building design and various element technologies (passive, active, renewable energy, and green remodeling technology).

Specifically, rather than covering all element technologies for construction of green buildings, the content focuses on element technologies deemed to be highly applicable to the country based on the characteristics of the region identified through a fact-finding survey of Pakistan. For example, among renewable energy sources, the content focuses on PV and solar thermal technologies that are deemed to be appropriate for application to Pakistan, as well as theory and case analysis, and the content on other renewable energy technologies focusing on basic theoretical content.

Finally, the education materials for this educational program will be written in English versions, and the English version will be provided to relevant organizations and locals we met in Pakistan

[Table] Educational program for Capacity building on green buildings sector

Classification	Education name	Type	Main content
Overview and System of Green Buildings	Overview of Green Buildings	Theory	- Concept and necessity of green buildings
	Green Building Certification System	Theory	G-SEED & LEED certification overview and certification method
	Suggestion standards for Pakistan Green Building Certification(PGBC)	Theory/ Evaluation	PGBC field composition and certification evaluation
Design and Cases of Green Buildings	Green Building Integrated Design	Theory	- Integrated design concept and theory of green buildings
	Detailed Design for Green Buildings Cases of Zero Energy Buildings in Korea	Case Case	- Passive detailed design cases including insulation details - Cases of Korean ZEB certification and ZEB buildings
Building Energy Savings	Building Insulation Technology	Theory/ Technology	- Importance of insulation, insulation/heat bridge theory, insulation technology
	Passive Building Technology	Technology	- Window area ratio, doors and windows, ventilation tech
	Active Building Technology	Technology	- High-efficiency equipment, heating and cooling technology, lighting
Renewable Energy Technology	Solar Thermal Technology and Cases	Theory/ Technology	- Technology and cases using solar heat

	PV Technology and Cases	Theory/ Technology	- PV, BIPV tech and cases
	Other Renewable Energy Technologies	Theory	- Geothermal heat, wind, fuel cell technology
Water circulation management	Water Saving Facilities in Buildings	Theory/ Technology	- Water-saving facility technology in buildings
	Heavy water facility technology and cases	Case	Heavy water facility principles and installation cases
	Rainwater Management Technology	Theory	Water circulation and groundwater utilization, rainwater management technology
Eco-friendly Materials	Eco-friendly construction materials	Technology	- Korea's eco-friendly construction materials
	Certification of eco-friendly construction materials	Evaluation	- Environmental Product Declaration (EPD) and evaluation
Ecological Environment and Maintenance	Building Greening & Ecological Technology	Theory/ Technology	Rooftop greening, wall greening, green space creation technology
	Building TAB & Commissioning	Theory	- TAB and commissioning overview and method
	BEMS Technology	Theory	Overview and content of building energy management systems

VIII. Recommendations: Institutional Foundations and Directions for a Successful Green Building Policy

The evaluation items and item-specific criteria are intended as draft materials that will need to be updated through the input from the local task force team, planning commission, and other experts in Pakistan. Below are additional measures to be taken, along with the proposed evaluation criteria, to ensure the successful implementation of green building in Pakistan.

- **Lay the foundation for industrialization by strengthening legal and policy grounds**: Efforts be made to reinforce the legal framework for green building certification and update relevant laws and regulations. This should include legislation to regulate and support the design, construction, operation, and maintenance of green buildings. Designating a government agency responsible for green building management, establishing a governance structure, and developing legal foundations will enable Pakistan to pursue the gradual industrialization of green building. In addition, building a sustainable green building ecosystem requires that the organization responsible for green building manage the rating system and work with stakeholders to ascertain that the system works in the best interest of the nation's green building mission and vision.

- **Designate an organization responsible for green building:** It is recommended that the Pakistani government designate an organization responsible for green building. This organization should form a technical working group for green building, which will perform tasks including policy review, feedback, demonstration of the certification system, and decision-making. This organization will also serve as the basic platform for communication between the government and stakeholders. It will contribute to the implementation of the Pakistan Green Building Code, the certification system, awareness-building, and training modules and programs.

  Designating a specialist authority will enable Pakistan to improve the quality and efficiency of green buildings, ensure the flexibility of policies in response to changes in market conditions, and minimize the environmental impact of buildings throughout their lifecycle. The designated authority should provide training and workshops to help the building industry keep pace with the latest green building techniques and technologies. It is also important for the government to continue gauging and adjusting their progress towards the SDGs and developing and implementing policies

that aim to gradually increase the number of buildings that meet international environmental standards through public-private partnerships. Furthermore, a regular review process should be in place to ensure that the national green building vision and mission are being achieved.

- **Organize public awareness campaigns**: Public relations activities and campaigns should be implemented to build public awareness of the importance and need for green building. The emphasis should be on promoting the advantages and benefits of green building.
- **Develop economic incentives in connection with international cooperation/support**: To ease the burden of upfront investment in green building, the government and international organizations should provide financial support to facilitate the adoption of green building certification systems. In addition, economic support programs and incentives can be used to promote voluntary acceptance (e.g. tax benefits, financial support, low-interest loans, etc.).

Develop local materials and technologies: Green building materials and technologies that are suitable for Pakistan's climate and environment should be developed and made available to the local market. This could include modernizing vernacular building methods.

Develop a monitoring system and collect and analyze data: A monitoring and verification system should be developed to measure and improve the performance of green building. This should include a system to evaluate the energy efficiency of buildings and resource use, among others. Efforts should also be made to systematically collect and analyze green building performance data to inform policy decisions.

These measures will play an important role in Pakistan's successful implementation of green building rating criteria and achievement of sustainable development.

IX. Conclusions

The objective of this study was to develop an evaluation system and criteria for green buildings in Pakistan. To achieve the country's ambitious goal of reducing its carbon emissions by 50% by 2030, it is essential to implement a rating system that recognizes the importance of green building and is tailored to the local climate and building conditions. The key findings from this study are outlined below.

① **Analyze the current situation in Pakistan and identify challenges**: A literature review and field research were conducted to gain insight into the current status of green building in Pakistan. The findings revealed that the country is facing challenges related to a lack of expertise, technical limitations, and awareness about green building.

② **Identify overseas best practices, conduct a SWOT analysis, and develop strategies**: A comparative analysis of green building policies and certification systems in various countries in the Asia-Pacific region was conducted to identify best practices applicable to Pakistan's context. This provided the basis for developing a green building rating system for Pakistan.

③ **Develop the PGBC**: Subsequently, the foundation was laid for the Pakistan Green Building Code, along with the development of a rating model and certification system. Five assessment areas were identified: land use and transportation, energy and pollution, materials and support, indoor environment, and post-completion actions (maintenance). Detailed calculation criteria and indicators were developed for each of these areas. A team of local experts in Pakistan will further develop these criteria and indicators. In addition, clarifications were made for the certification process, level-specific scoring criteria, operations, and application.

④ **Recommend policy support measures**: It was recommended that the successful implementation of green building be ensured by establishing an institutional framework and policy support. This will serve as a policy driver to disseminate green building practices across Pakistan.

In conclusion, this study will contribute to the achievement of Pakistan's carbon reduction targets and the achievement of the SDGs. The introduction of the PGBC rating system and certification scheme will play an important role in improving the energy efficiency of

buildings and easing the environmental burden by providing green building standards that take into account Pakistan's diverse climate conditions and built environment. Furthermore, they will serve as an essential element in strengthening the resilience and sustainability of Pakistan's construction industry, which will in turn play an important role in helping the country achieve global environmental goals.

X. Appendix

Appendix 1. Five most populated cities in Pakistan and their features for future green building master planning

No.	City	Population (2017) [33]	Features	Federal jurisdiction
1	Karachi	14,916,456	- The largest city in Pakistan and the capital of Sindh Province; the world's fourth most populated city; a port city. - A commercial and industrial city that is home to the stock exchange and banks[15]. - At least 50 150+ meter-tall buildings under construction in 2022; declining in urban livability rankings due to rapid urban growth, insufficient housing infrastructure, and poor urban planning and transportation policies[16].	Sindh Province
2	Lahore	11,126,285	- Pakistan's second largest city and the capital of Punjab Province in Pakistan's northeast; the nation's center of business, industry, and education[15]. - A city with a GDP similar to Karachi's in 2008[34] and an estimated share of 19% in Punjab Province's economy[35]. - Second largest financial hub; accounting for ~13% of the country's GDP[36].	Punjab Province
3	Faisalabad	3,204,726	- The richest city in Pakistan with the largest industrial hub; contributes 20+% of the country's GDP[36]. - Industries: agriculture, engineering, textile, food processing, grain milling, chemical, etc.[37]. - Significant funding from local governments to improve infrastructure, etc.[38]. - The Faisalabad Chamber of Commerce and Industry (FCCI) recognizes the importance of the development of renewable energy resources and infrastructure and is working to attract foreign investment[39], [40], [39]. - In 2023, German renewable energy company CAE announced a plan to construct a solar panel plant in Faisalabad[41].	Punjab Province
4	Rawalpindi	2,098,231	- A large city in the outskirt of Islamabad; social and economic connections to Islamabad. - Industries: refineries, gas processing, steel, mills, textiles[36].	Punjab Province
5	Gujranwala	2,027,001	- Pakistan's third largest industrial hub after Karachi and Faisalabad[42], accounting for 5% of the country's GDP[36]. - Industries: textile and other equipment, parts manufacturing[36], agriculture. - Ranked 6th among the top 13 cities in Pakistan in the World Bank's Ease of Doing Business index; 2nd for building permit processing[43].	Punjab Province

Appendix 2. Architectural forms and passive design elements of vernacular houses in Pakistan (adapted from [23])

Principal Cities	Climate	(Regionally available construction) Materials	Passive Design
Giltgit, Chitral, Sakardu, Swat, Peshawar, Kohat, Waziristan, Quetta, Sibi and Kalat etc.	Highland	Timber, stone, mud bricks, clay and soil mortar	Skylight, stair hall, light ways, terraces, extended shades, Shaded Verandas, Potholes, Courtyard
Islamabad, Lahore, Faisalabad, Multan, Jacobabad, Shikapur, etc.	Lowland	Earthen materials like moulded mud or clay blocks, pise, sun dried and burnt bricks, kankar, white lime mortar and plaster, terracotta tiles, sheesham and neem wood, Wooden windows with iron bars in checker form(Punjabi houses), -Floor made of composite material using earth mixed with water and straw or dung(Increasing thermal conductivity), 6-9 inch thick y	-Wooden openings and thick mud plastered walls(increase the time lag of walls to the inside), -Reinforced concreted thick walls in some houses, elongated ventilators, screen geometric pattern, extended porches, roof shading, Column beam structure ("Pakka houses")
Indus delta, Karachi, and Makran coast.	Coastal (High humidity conditions))	Mud and cement sand block, Acacia and Sheesham timber frames, straw and earth plaster	High ceiling, central ridge, and double slope roof, cross ventilation, projected balconies, screens, lattices, wind catchers
Tharparkar (South-eastern provision of Sindh)	Arid	Granite rocks and crystalline rocks, straw, stone and timber ("Pucca house")	Ventilators, hut style room with thatched roofs of thick straw or reed supported by beams, traditional ponds and wells, Sundried bricks and plastered with mud finish for walls, wooden frame windows and doors

Appendix 3. Comparison table of EP-2011 and ECBC2023

Aspect	**Building code of Pakistan (Energy Provision-2011)**[25]	**Energy Conservation Building Code (ECBC) 2023**[29]
Target	• New commercial building and their systems • New portions of existing buildings and their systems, if the conditioned area or connected load exceeds the scope below • New systems and new equipment in existing buildings • Increase in the electricity load beyond the limit of the scope below	• The ECBC 2023 applies to both residential buildings and commercial building • New commercial building and their systems • New portions of existing buildings and their systems, if the conditioned area or connected load exceeds the scope below • New systems and new equipment in existing buildings • Increase in the electricity load beyond the limit of the scope below
Scope	• Total connected load: 100kW or greater or • Contract demand: 125kVA or greater or • Conditioned area: 900m2 or greater or • Unconditioned buildings of covered area: 1,200m2 or more	• Total connected load: 50kW or greater or • Contract demand: 75kVA or greater or • Conditioned area: 200m2 or greater or • Unconditioned buildings of covered area: 300m^2 or more
Building Systems Covered	• Building envelopes • Building mechanical systems and equipment, including HVAC (Heating, Ventilating and Air Conditioning) • Service Water Heating • Lighting • Electrical power and motors	• Building envelopes • Building mechanical systems and equipment, including HVAC (Heating, Ventilating and Air Conditioning) • Service Water Heating • Lighting • Electrical power and motors • Others (Energy Management, Passive Design, renewable and geothermal energy, Electric vehicle charging points, water reuse systems)
Exemptions	• Buildings using renewable energy sources • Government-notified heritage buildings • Equipment for manufacturing processes	
Applied Standards	• Follows testing procedures based on ASHRAE 90.1-2004, 2013 standard • Includes ARI, NEECA, SMACNA, AABC standards	• Uses parts of ASHRAE Standard 90.1-2019, ASHRAE Applications Handbook, ASHRAE Standard 111

			• References ASHRAE, ANSI, ARI, ASTM standards, uses ICC energy conservation code
Climate Classification		• General guidelines, no detailed climate zone classification • A single climate zone for building based on ASHRAE Standard 90.1 – 2013, with Pakistan being designated as Climate Zone1, Centered around Karachi[44]	• Detailed classification into seven climate zones: Hot and Dry, Hot and Humid, Temperate and Humid, Temperate Mixed, Cool and Humid, Cool and Dry, Cold and Humid
Applicable Elements	**Building Envelope Standards**	• U-values for walls and roofs, heat transmission coefficients, shading coefficients, air leakage standards	• Detailed standards, including U-values, SHGC, insulation and air sealing requirements
	HVAC Systems Standards	• Requirements for controls, mechanical ventilation, cooling towers, piping and ductwork, system balancing, minimum equipment efficiencies	• Comprehensive standards for equipment efficiency, ductwork design, and energy-efficient operation
	Service Water Heating Standards	• Standards for piping insulation and equipment efficiency	• Enhanced standards for water heaters, including equipment efficiency and insulation requirements
	Lighting and Electrical Power Standards	• Standards for lighting power density and efficiency of electrical systems and motors	• Updated standards for energy-efficient fixtures, lighting controls, and strategies to reduce energy consumption
	Renewable Energy and EV Charging	• None	• Provisions for renewable energy systems and EV charging infrastructure
	Passive Design	• None	Encouraged to use.. • Passive design techniques such as natural ventilation • Solar gai1n and rejection • Use of geothermal energy
Implementation Plan		• Mandatory compliance, outlined enforcement mechanism	• Structured and detailed plan, compliance documents including energy simulation models required
Administrative Authority		• Relevant local authorities	• NEECA with collaboration from Provincial Designated Agencies (PDAs)
Enforcement Mechanisms		• Compliance mandatory for applicable buildings, guidelines for permits and interpretation of code provisions	• Regular inspections, penalties for non-compliance, maintenance of energy consumption records required
Notable Features		• Basic energy efficiency standards for larger buildings and systems	• Broader scope, detailed standards, sustainable practices, renewable

		energy, modern energy management systems
Update and Revision Cycle	• Initial comprehensive provisions, lacking some areas compared to recent standards	• Regular revisions every three years, interim updates possible, aligns with SDGs and Paris Agreement
Case of any conflict	The relevant provisions of Safety, Health, or Environmental Codes shall prevail.	

Appendix 4. Pakistan's green building rating system and item-specific scores

Categories	Evaluation Items	Evaluation	Points (Residential)	Points (Non-residential)	Remarks
A.: Site Planning & Development (Points: 17)	A.1 Ecological value of existing land	Existing land's ecological value, land use, zoning, etc.	2	2	
	A. 2 Minimizing soil cut/fill in earthwork	Sum of the absolute amounts of fill and cut for topographic change over the entire land area	2	2	Pakistan to consider necessity
	A.3 Validity of measures to prevent natural light interference	The maximum elevation angle from the adjacent property's boundary to the building's north-facing elements	3	3	
	A.4 Heat wave response and heat island effect mitigation plan	Installations for heatwave and heat island effect mitigation	3	3	
	A.5 Building connected green space axes	Connections to the internal and external green axes	2	2	
	A.6 Ecological area ratio (mandatory)	Presence and proportion of areas with natural circulation functions in relation to outdoor space	3	3	
	A. 7 Accessibility to public transport and amenities	Access and proximity to public transportation and amenities	2	2	
B. Energy & Environmental Pollution (Points: 30)	B.1 Building envelop & opening (mandatory)	Energy performance assessment: Performance criteria for each part of the building	17	17	

* Green buildings in response to energy and climate change	B.2 Prohibition of specific materials to protect ozone layers	Ozone depleting substance standards to address global warming	3	3	Additional: Proposed for expected effects for green industry development
	B.3 Use of renewable energy sources	Percentage of renewable energy supply	8	6	Moved from C to B
	B.4 Lighting energy saving (non-residential)	Light density and lighting type	0	2	Moved from C to B
C. Resource Efficiency (Points: 21) * Materials and resources + water	C.1 Building material substantiality (mandatory)	Use of Eco-label certified products, Good Recycled Product certified products and equivalent	6	6	Moved from B to C
	C.2 Water efficiency (mandatory)	Application of Eco-label certified water saving products	6	6	
	C.3 Rainwater management (additional)	Presence of stormwater retention facilities for sprinkler water, landscaping water, etc.	3	3	Added: Emphasis on Pakistan's need for water resources (Review Draft Deliverable2. 8p, Vision 2030 ...)
	C.4 Solid & Liquid Wastes Management (mandatory)	Recyclable domestic waste storages and sorting of recyclables	6	6	
D. Indoor Environmental Quality (Points: 24)	D. 1 Use of low indoor air pollutant discharging materials (mandatory)	Use of low VOC materials	9	9	
	D.2 Tobacco smoke control	Smoke-free building or smoke-free policy	1	1	

	D.3 Natural lighting (residential buildings)	Minimum natural light performance measured as average daylight factor (DF) and uniformity factor	6	0	
	D.4 Resting and refreshing area	Designated areas for building users (customers/employees) to rest and refresh	0	6	Added: for non-residential buildings
	D.5 Natural & controlled ventilation	Installation of windows and ventilation systems for residents to control to bring in fresh air	8	8	Moved from B to D
E. Post-Completion Green Building Actions (Points: 8)	E.1 Environmentally-friendly space planning and management	Building's green elements and engagement of green building certified professionals in design	2	2	
	E.2 Construction site environment management	Contractor's establishment and implementation of a construction site environmental management plan	2	2	
	E3. Operation and maintenance	Manuals for managers and users	3	3	
	E4. Monitoring	Continuous monitoring throughout the building lifecycle (energy, water consumption, air quality data)	1	1	
Total			**100**	**100**	-

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	A.1. Ecological Value of Existing Land	**POINT**	2	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Protect environmentally valuable land resources by evaluating the environmental and ecological value of existing land.				
SDGs					
METHOD	Scoring based on existing land's ecological value, land use, zoning, etc.				
DETAILS					
POINTS	2 (Evaluation Item)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				
RATING STANDARD	• Score = (Weight) x (Points Allocated)				

Level	Ecological value of existing land	Weight
1	Land with low ecological value land ≥ 80% of land area	1.0
2	Land with low ecological value land ≥ 70% and < 80% of land area	0.8
3	Land with low ecological value land ≥ 60% and < 70% of land area	0.6
4	Land with low ecological value land ≥ 50% and < 60% of land area	0.4

- Land with low ecological value: Meets any of the following conditions

· Previously used land (reused land)

· Full remodeling

· Ecologically damaged land from being used as landfill or suchlike

- Large-scale development sites such as housing development districts, coastal and wetland landfills, etc. are not considered land with low ecological value.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- USGBC LEED Green Building Rating System. - The National Land Planning and Utilization Act and its Enforcement Decree related to the subdivision of land use and zoning may be of relevance.

	- Documents that elucidate the status of urban ecology in Pakistan can be referenced; if not, relevant guidelines should be prepared.
SUBMISSION DOCUMENT	Satellite or aerial photography On-site photos Urban planning verification certificate Land use plan certificate Land use change certificate

Appendix 6

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	**A.2.** Minimizing Soil Cut/Fill in Earthwork	**POINT**	2	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Minimize the amount of cut and fill in earthwork by encouraging the utilization of existing topography and planning for less disturbance.
SDGs	
METHOD	Sum of the absolute amounts of fill and cut for topographic change over the entire land area
DETAILS	
POINTS	2 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Score = (Weight) x (Points Allocated)

$$\text{Soil cut/fill (\%)} = \frac{\text{Soil cut/fill (m3)}}{\text{Total earthwork volume (m3)}} \times 100$$

Level	Minimizing soil cut/fill in earthwork	Weight
1	The absolute value of the sum of the soil cut and fill volume in the site (soil cut/fill amount) ≤ 100% of the total site area × 1 meter (total earthwork volume)	1.0
2	The absolute value of the sum of the soil cut and fill volume in the site (soil cut/fill amount) ≤ 200% of the total site area × 1 meter (total earthwork volume)	0.8
3	The absolute value of the sum of the soil cut and fill volume in the site (soil cut/fill amount) ≤ 300% of the total site area × 1 meter (total earthwork volume)	0.6
4	The absolute value of the sum of the soil cut and fill volume in the site (soil cut/fill amount) ≤ 400% of the total site area × 1 meter (total earthwork volume)	0.4

- Total earthwork volume (m^3): Total land area (m^2) × 1m

- Soil cut/fill(m^3): Soil cut (m^3) + soil fill (m^3)

- Excavation and backfill for building foundations, basements, etc., is not included in the soil cut/fill volume.

REFERENCE MATERIALS & SUBMISSION DOCUMENT

REFERENCE MATERIALS	- Standard Specifications for Construction Work, Ministry of Land, Infrastructure, and Transport - Complex Construction Design and Estimation Standards, Korea Land and Housing Corporation, 2009
SUBMISSION DOCUMENT	- Cadastral maps (area, contour lines) - Civil engineering plans (cross sections, longitudinal sections, soil cut and fill plans) - Site photography - Earthwork estimates (including total cut and fill estimation) - Land use plan certificate

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	**A.3.** Validity of Measures to Prevent Natural Light Interference	**POINT**	3	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Encourage the structure to avoid blocking sunlight to neighboring properties, taking into account conflicts with existing structures and potential impacts on future development projects.
SDGs	
METHOD	The maximum elevation angle from the adjacent property's boundary to the building's north-facing elements
DETAILS	
POINTS	3 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	Score = Weight X Points allocated Maximum elevation angle = arctan (Height of building / Distance between the building and the neighboring property line to the north)

Level	Maximum elevation angle range	Weight
1	Maximum elevation angle < 40°	1.0
2	Maximum elevation angle ≥ 40° and < 45°	0.8
3	Maximum elevation angle ≥ 45° and < 50°	0.6
4	Maximum elevation angle ≥ 50° and < 55°	0.4

	- The maximum elevation angle is the angle of the north-facing elevation of the elements of the building from the adjacent property line.
REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Building height provisions in Pakistan's building code for daylight, etc. Example) Article 61 of the Building Act of Korea and Article 86 of its Enforcement Decree (height limitation of buildings for sunlight, etc.) - Green building design guidelines from Pakistan's government departments related to construction/architecture

	(Korea: Design Guidelines for Eco-friendly Buildings (Ministry of Construction and Transportation, December 1999))
SUBMISSION DOCUMENT	- Plot - Cross/longitudinal sectional views - Maximum evaluation angle estimation

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	**A.4.** Heat Wave Response and Heat Island Effect Mitigation Plan	**POINT**	3	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Encourage building plans to incorporate responses to heat waves and heat island effect as they aggravate due to climate change				
SDGs					
METHOD	Scoring based on heatwave and heat island effect mitigation plans				
DETAILS					
POINTS	3 (Evaluation Item)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				

RATING STANDARD

Scoring

Level	Heatwave and heat island effect mitigation measures	Point
1	At least 3 installations for heatwave and heat island effect mitigation	3.0
2	2 installations for heatwave and heat island effect mitigation	2.0
3	1 installation for heatwave and heat island effect mitigation	1.0

Climate change response plan	Location and type	Example
Buildings, facilities, installations to mitigate heatwave and heat island effect	Building facade/roof	Wall greening
		Wall insulation paint
		Cool roof paint
		Rooftop greening
		Roof spraying
		Insulation film
		Building exterior shade
	Space	Heat wave shelters
		Temporary protection

			Other	Portable cool mist (cooling fog)
				Fixed cool mist (cooling fog)
				Coot jet
				Heated and cooled chair
				Air curtain
				Shade
REFERENCE MATERIALS & SUBMISSION DOCUMENT				
REFERENCE MATERIALS	-			
SUBMISSION DOCUMENT	- Plot - Cross/longitudinal sectional views - Maximum evaluation angle estimation			

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	**A.5.** Building Connected Green Space Axes	**POINT**	2	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Create continuous green space within the site and encourage connections to external green space				
SDGs					
METHOD	- Assessment based on the length ratio of the internal green space axis - If the internal green space axis is connected to an external green space, assessment based on the length ratio and length of the connection				
DETAILS					
POINTS	2 (Evaluation Item)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				

RATING STANDARD

• Scoring with Rating Method 1 or Rating Method 2

Level	Length ratio of green axis on site	Point
1	Internal green space axis length ≥ 50% of total site circumference (0.50×A ≤ L)	2.0
2	Internal green space axis length ≥ 40% and < 50% of total site circumference (0.40×A ≤ L < 0.50×A)	1.6
3	Internal green space axis length ≥ 30% and < 40% of total site circumference (0.30×A ≤ L < 0.40×A)	1.2
4	Internal green space axis length ≥ 20% and < 30% of total site circumference (0.20×A ≤ L < 0.30×A)	0.8

[Rating Method 2]

• Score = Based on the length of the internal green space axis and length of the connection to external green space axis

If the internal green space axis is connected to an external green space (including biotop), score = Item 1) + Item 2)

Level	If connected to an external green space (including biotop)	Point
1	Item-specific score 2.0	2.0
2	Item-specific score ≥ 1.6 and < 2.0	1.6

3	Item-specific score ≥ 1.2 and < 1.6	1.2
4	Item-specific score ≥ 1.0 and < 1.2	0.8

1) Degree of connection of the internal green space axis to an external green space (including biotop)

Degree of connection of the internal green space axis to an external green space (including biotop)	Point
Width of connection of the internal green space axis to an external green space (including biotop) ≥ 8m	1.0
Width of connection of the internal green space axis to an external green space (including biotop) ≥ 6m	0.8
Width of connection of the internal green space axis to an external green space (including biotop) ≥ 4m	0.6

2) Internal green space axis length ratio

Internal green space axis length ratio	Point
Internal green space axis length ≥ 25% of total site circumference (0.25×A ≤ L)	1.0
Internal green space axis length ≥ 20% and < 25% of total site circumference (0.20×A ≤ L < 0.25×A)	0.8
Internal green space axis length ≥ 15% and < 20% of total site circumference (0.15×A ≤ L < 0.20×A)	0.6
Internal green space axis length ≥ 10% and < 15% of total site circumference (0.10×A ≤ L < 0.15×A)	0.4

- L : Internal green space axis length, A: Total site circumference

- The green space axis should consist of multi-layered planting and quality soil growth environment (vegetation, soil, water resources, etc.) to enable the habitat and movement of living organisms.

- The green space axis should be at least 4 meters wide with disconnections no greater than 1 meter; up to 3 meters of sectional disconnections allowed.

- A green space axis is recognized if it has a walkway that is less than 1 meter in width, constructed with connections to the planting surface, such as stone paving, etc.

REFERENCE MATERIALS & SUBMISSION DOCUMENT

REFERENCE MATERIALS

-

SUBMISSION DOCUMENT

- Planting plan
- Cross-sectional view of green space axis
- Green space axis length estimation
- Design description with green space axis
- Proof of green space planning

	- (For implementation) On-site installation photography

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	A.6. Ecological Area Ratio	**POINT**	3	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Quantitatively evaluate changes in the ecological functions of the land (soil circulation, rainwater circulation, air and climate regulation, habitat, etc.) due to change sin land cover to prevent urban climate change and other ecological problems and pursue ecological soundness.
SDGs	
METHOD	Evaluate the ecological area ratio as a ratio of the total land area to the sum of the ecological areas calculated by categorizing space (cover) types and multiplying each space (cover) type by the corresponding coefficient; evaluate the degree of enhancement in consideration of the statutory building coverage ratio of the site.
DETAILS	
POINTS	3 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	Presence and proportion of areas with natural circulation functions in relation to outdoor space • Score = (Weight) x (Points Allocated) $\text{Ecological area ratio enhancement} = \frac{\text{Ecological area ratio (\%)}}{\text{100\% –statutory building coverage ratio (\%)}}$ $\text{Ecological area ratio (\%)} = \frac{\text{(Converted area by cover type *+ Converted area by planting type**)}}{\text{Total land area}} \times 100$ * Converted area by cover type = Area of natural circulation function = Σ(area by cover type × coefficient) ** Converted area by planting type = planting area = Σ(Number of plants × converted area × coefficient)

Cover type		Weight	Space (cover) type description
1	Natural ground green space	1.0	- Natural or created green space on the ground

2	Water space (permeability)	1.0	- Water space with groundwater holding properties - Coefficient = 0.5 for water space with cutoff facilities on the ground
3	Artificial ground green space ≥ 90 ㎝	0.7	- Green space on artificial ground with an effective soil depth ≥ 90 ㎝ - If soil depth < 90cm, coefficient = 0.5 (minimum soil depth 40cm)
4	Rooftop greening ≥ 40 ㎝	0.6	- Space with multi-layer planting with an effective soil depth ≥ 90 ㎝ - If soil depth < 40cm, coefficient = 0.4
5	Permeable pavement (including planting)	0.4	- If net pavement area is 50% or more or if no planting, weight = 0.2 (0 for impermeable pavement)
6	Wall greening	0.3	- Greening of windowless walls or retaining walls, up to 10 meters high (minimum soil depth 20 cm)
7	Interfaces with retention and infiltration facility	0.1	- Interfaces with stormwater infiltration for groundwater enrichment or temporary retention facilities

Planting type			Coefficient	Note for planting type determination
8	Planting height	Converted area	0.1	- Deciduous trees H≥4m, B≥12cm, or R≥15cm - 2 evergreen tall trees H≥4m, W≥2m - Deciduous trees H≥5m, B≥18cm or R≥20cm - 4 evergreen tall trees H≥5m, W≥3m - Deciduous trees H≥5m, B≥25cm or R≥30cm - 8 evergreen tall trees H≥5m, W≥5m * For shrubs with a height of 1.5 meters or higher, 50% of 0.3 (0.15).
	0.3m -1.5m	0.1		
	1.5m-4.0m	0.3		
	Higher than 4.0m	3.0		

REFERENCE MATERIALS & SUBMISSION DOCUMENT

REFERENCE MATERIALS

* Adjustments needed depending on the local climate zone, green space creation technology and market conditions in Pakistan

Following materials or similar sources in Pakistan

- Research on core technology development for ecological cities
- Measures to use ecological metrics for urban planning
- Research on the introduction of ecological area ratio standards

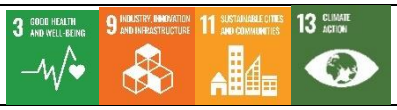
Other relevant resources on open green space

Other reference materials from Korea

- Seoul Ecological Area Ratio Operating Guidelines, Seoul Metropolitan City

	- Report on the Improvement of Ecological Area Ratios, December 2015, Seoul Metropolitan City
SUBMISSION DOCUMENT	- Design drawings (plot, ecological area ratio/green space map, planting plans/pavement plans, pavement/underground structure, etc.) - Ecological area ratio estimation (with space type and estimation formula) - Water permeability test report for permeable pavement - Site photography

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	A. Site Planning & Development			
	CRITERIA	**A.7.** Accessibility to Public Transport and Amenities	**POINT**	2	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Reduce carbon emissions and conserve energy by curbing traffic with the use of public transportation and local amenities adjacent to the site.
SDGs	
METHOD	Evaluation based on the walking distance to public transportation (railroad, bus, port, etc.), the number of public transportation facilities, and the number of living amenities within a certain radius from the site entrance.
DETAILS	
POINTS	2 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	Score: Public transport score + living amenities score

Level	Walking distance to public transportation	Point
1	2 or more public transports within 300m	1.0
2	Nearest public transport within 200m	0.8
3	Nearest public transport at a distance of 200m – 300m	0.6
4	Nearest public transport at a distance of 300m – 400m	0.4

- A public transportation facility is a facility necessary for the operation of public transportation under the Act on the Support and Promotion of Use of Public Transportation.

- Types of public transportation facilities include railroad, bus, passenger ports, and passenger flights.

- Walking distance is a physical distance via the safest and most convenient route.

- Distance is measured as the walking distance from the pedestrian path entrance to the public transportation facility.

- Village bus stops and airport limousine stops are counted as bus facilities.

Level	Distance from the site entrance to living amenities	Point
1	Living amenities within a 500m radius from the site entrance	1.0

	2	Living amenities within a 600m radius from the site entrance	0.8
	3	Living amenities within a 700m radius from the site entrance	0.6
	4	Living amenities within a 1km radius from the site entrance	0.4

- A living amenity facility is a neighborhood living facility that meets the basic needs in daily living and the following conditions:

. Living amenities should include at least 10 types of living amenities.

. Class 1 and Class 2 neighborhood living facilities under Article 3-5 of the Enforcement Decree of the Building Act and parks

Some Class 2 neighborhood living facilities (bars, massage shops, and singing rooms) are excluded.

- Living amenities are facilities that are central to the lives of urban residents, such as medical, educational, and public facilities.

- Urban living amenities should include at least four of the following: medical, retail, cultural, religious, senior and children, educational, sports, business, and accommodation.

- Distance to a living amenity is measured as a radius distance from the site entrance. The site entrance is the primary or secondary entrance, whichever is more convenient.

- Redundant facilities are counted as one facility.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Act on the Support and Promotion of Use of Public Transportation, Ministry of Land, Infrastructure, and Transport
SUBMISSION DOCUMENT	- Plot - Cross/longitudinal sectional views - Land use plan for the housing development district (traffic impact assessment improvement plans) - Photos of stops for public transportation facilities - Location maps of the primary and secondary entrances and living amenities (with a radius diagram) - Housing development plan, district unit plan - Complex plan - Vicinity map (locations of public transportation facilities and pedestrian entrances, distance from public transportation facilities to the pedestrian entrances) - Data related to public transportation facilities adjacent to the building (urban railroad masterplan, etc.)

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	B. Energy & Environmental Pollution			
	CRITERIA	**B.1.** Building Envelop and Opening	**POINT**	17	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Building energy consumption is closely related to greenhouse gas emissions from the use of fossil fuels. Energy savings in buildings lead to reductions in greenhouse gas emissions. In this context, pre-evaluation of energy consumption in building operations, which account for the largest portion in the building's lifecycle energy consumption, contributes to saving energy and reducing greenhouse gas emissions.
SDGs	
METHOD	Performance criteria for each part of the building.
DETAILS	
POINTS	17 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Score = (Weight) x (Points Allocated)

Level	**Element-specific criteria**										**Weight**
	Overall heat transmission	**Overall heat transmission**	**Window and**	**Overall heat transmission**	**Overall heat**	**Overall heat**	**Insultation type**	**Airtightness (50 Pascal)**	**Boiler efficiency**	**Waste heat**	
1	1.0	1.6	≤ 20 %	0.15	0.15	0.15	External	0.6 times/hour	≥ 87%	Yes	1.0
2	1.4	2.0	≤ 25 %	0.20	0.16	0.19	External	-	≥ 87%	Yes	0.85
3	1.8	2.4	≤ 25 %	0.25	0.17	0.23	-	-	≥ 87%	-	0.70
4	2.1	2.8	≤ 25 %	0.30	0.18	0.27	-	-	≥ 87%	-	0.55

	5	2.4	3.2	≤ 25 %	0.36	0.20	0.30	-	-	≥ 87%	-	0.40

※Overall thermal transmission of windows, doors, walls, roofs, and floors based on their minimum values

- Also consider the Energy Conservation Building provisions.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Building energy efficiency rating regulations in Pakistan
SUBMISSION DOCUMENT	- Supporting data to determine the energy efficiency rating (Drawings, test results, or estimation of insulation properties and thermal transmission, etc.)

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	B. Energy & Environmental Pollution			
	CRITERIA	B.2. Prohibition of Specific Materials to Protect Ozone Layers	**POINT**	3	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Reduce the use and emissions of certain ozone depleting substances to combat global warming				
SDGs					
METHOD	Ozone depleting substance standards to address global warming				
DETAILS					
POINTS	3 (Evaluation Item)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				
RATING STANDARD	• Sum of item-specific scores				

Reducing ozone depleting substances	Point
Refrigerant's ozone depletion potential (ODP) ≤ 0.03 or global warming potential (GWP) ≤ 1,600	1
More than 80% of insulation materials' ODP ≤ 0.03 or GWP ≤ 1,600	1
Installing halon-free fire extinguishers	1

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Pakistani laws and regulations equivalent to Korea's Act on Regulation of Manufacture of Certain Substances for Protection of Ozone Layers - IPCC Fourth Assessment Report: http://www.ipcc.ch/ipccreports/ar4-wg1.htm), Chapter2 - Kyoto Protocol to the United Nations Framework Convention on Climate Change - Halon control measures under the Montreal Protocol - Ozone depletion potential (ODP) is the ratio of the impact on ozone of a chemical compared to the impact of a similar mass of CFC-11 being 1. - Global warming potential (GWP) is the relative impact of a substance on global warming compared to the global warming impact of carbon dioxide (CO2) being 1.

	- This criteria consider the need to apply a GWP with a duration of 100 years as per the Intergovernmental Panel on Climate Change's (IPCC) "Climate Change 2007" Fourth Assessment Report.
SUBMISSION DOCUMENT	- Details of refrigerants used in the air conditioning system. - Types of insulation materials and specifications of specific materials used. - Fire extinguisher performance certificate ※Specifications may be used in lieu.

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	B. Energy & Environmental Pollution			
	CRITERIA	B.3. Use of Renewable Energy Sources	**POINT**	Residential: 8 Non-residential: 6	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	The use of renewable energy sources contributes to reducing the use of fossil fuels and the greenhouse gas emissions therefrom. This item is intended to encourage and promote the use of renewable energy.
SDGs	
METHOD	Percentage of renewable energy supply installations
DETAILS	
POINTS	Residential: 8 (Evaluation Item) Non-residential: 6 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Score = (Weight) x (Points Allocated)

Level	Percentage of renewable energy supply installations	Weight
1	Sum of scores for renewable energy installations ≥ 3	1.0
2	Sum of scores for renewable energy installations ≥ 2	0.8
3	Sum of scores for renewable energy installations ≥ 1	0.6
4	Renewable energy has been installed	0.4

Category	Renewable energy system (Unit or household average)	Point
Solar (fixed, tracking, BIPV)	3kW or more	3
	2kW or more	2
	1kW or more	1
Solarthermal	30 ㎡ or more	3

		(flat panel, single vacuum tube, dual vacuum tube)	20 ㎡ or more	2
			10 ㎡ or more	1
		Small wind	3kW or more	3
			2kW or more	2
			1kW or more	1
		Geothermal (vertically enclosed)	17.5kW or more	3
			10kW or more	2
		Fuel cells	1.0kW or more	3
			0.6kW or more	2

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Pakistani laws and regulations equivalent to Korea's New Energy and Renewable Energy Development, Use and Supply Promotion Act - Guidelines provided by Pakistan's Energy Management Authority, etc.
SUBMISSION DOCUMENT	- Renewable energy facility installation drawings and ratio calculations - On-site installation photos (for implementation)

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	B. Energy & Environmental Pollution			
	CRITERIA	B.4. Lighting Energy Saving	**POINT**	Non-residential 2	Evaluation Item

PURPOSE AND METHODS

PURPOSE	Save energy and ensure a comfortable vision for users with efficient lighting design.
SDGs	
METHOD	Business, schools, and retail facilities: Evaluation of lighting density and methods

DETAILS

POINTS	Non-residential: 2 (Evaluation Item)
RATING TARGET	Non-residential Building : Entire Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Score = Level-specific (Weight) × (Points)

Business			School			Retail		
Level	**Score**	**Weight**	**Level**	**Score**	**Weight**	**Level**	**Score**	**Wegith**
1	10 or higher	1.0	1	9 or higher	1.0	1	10 or higher	1.0
2	8 or higher	0.8	2	6 or higher	0.7	2	8 or higher	0.8
3	7 or higher	0.6	3	3 or higher	0.4	3	7 or higher	0.6
4	4 or higher	0.4	-	-	-	4	4 or higher	0.4

Criteria	Business/school	Retail	Point
Average ceiling lighting density of various spaces used for different purposes	≤ 9 W/m2	≤ 2.25 W/(m2·100Lux)	9
	≤ 12 W/m2	≤ 3.00 W/(m2·100Lux)	6
	≤ 15 W/m2	≤ 3.75 W/(m2·100Lux)	3
Natural lighting	Daylight sensors to automatically adjust illumination to take advantage of natural light		2
Lighting density and lighting control in indoor parking lots	Designed ≤ 2 W/m2 or daylight sensors to automatically adjust illumination		1

- Louvers should be installed on fixtures to prevent glare, if direct lighting (office areas in business buildings and classrooms in schools).

	- Evaluated if the space used for the primary use of the building meets the standard illuminance for the work area according to KS A 3011 (400 Lux for business/school facilities).
REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Building energy efficiency rating regulations in Pakistan
SUBMISSION DOCUMENT	- Supporting data to determine energy efficiency rating

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	C. Resource Efficiency			
	CRITERIA	C.1. Building Material Substantiality	**POINT**	6	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Evaluate the use of eco-friendly certified products for resource recycling to achieve resource circulations, intrinsic energy reduction, and environmental pollution mitigation.				
SDGs					
METHOD	Use of Eco-label certified products, Good Recycled Product certified products and equivalent				
DETAILS					
POINTS	6 (Mandatory item: Minimum score 2.4)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				
RATING STANDARD	Score = Level-specific score (Weight) × (Point)				

Level	Use of certified green products	Weight
1	9 products or more	1.0
2	7 products or more	0.8
3	5 products or more	0.6
4	3 products or more	0.4

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Green products as defined by relevant codes in Pakistan, comparable to the Green Products Promotion Act in Korea (Eco-label certification, Good Recycled certification, etc.) - Criteria for granting green label certification (e.g., http://el.keiti.re.kr) - Pakistani certification bodies and quality standards comparable to the Good Recycled Products Certification (e.g., http://www.kats.go.kr/gr, www.ripa.or.kr) - Green product information (e.g., http://www.greenproduct.go.kr) - Good Recycled product certification guide - Laws and enforcement decrees/regulations on the conservation of resources and recycling promotion

SUBMISSION DOCUMENT	- Material-specific certificates and track records ※Confirmation of intended application may be used in lieu. - (For implementation) Photos of products installed on-site

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	C. Resource Efficiency			
	CRITERIA	C.2. Water Efficiency	**POINT**	6	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Growing water demand driven by urban population growth leads to deteriorating water quality and increasing costs of municipal sewage treatment. Evaluating domestic water consumption contributes to reducing energy, water supply, and sewage treatment facilities and costs.
SDGs	
METHOD	Application of Eco-label certified water saving products
DETAILS	
POINTS	6 (Mandatory item: Minimum score 2.0)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	Sum of item-specific scores At least 80% of the Eco-label certified products applied to all floors

Eco-label certified products		Point
Water-saving faucets	Instantaneous blocking (electromagnetic, pedal, and foot valve), self-closing, quantitative blocking, and water-saving faucet attachments (for basins only).	2.0
Showerheads	Showerheads with valves, on/off showerheads, instantaneous blocking showerheads, and other water-saving showerheads	2.0
Water-saving toilets and urinals	Water-saving toilets, toilet fittings, urinals, etc.	2.0

※Excluding faucets for washing machines, etc., where water-saving features are deemed unnecessary.

※ Excluding faucets outside residential units.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	Pakistani laws relevant or similar to the following: - Water laws - Environmental technology and environmental industry support laws - Eco-labeling system

	- Products eligible for eco-label certification and certification standards (e.g., http://el.keiti.re.kr)
SUBMISSION DOCUMENT	- Related design documents - Marks or documents demonstrating the green labeling of the product

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	C. Resource Efficiency			
	CRITERIA	C.3. Rainwater Management	**POINT**	3	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Utilizing stormwater can help reduce water consumption, suppress stormwater runoff during rainfall, and recycle stormwater as water resources. It also contributes to energy savings and the downsizing of public facilities and the efficient use of water resources.				
SDGs					
METHOD	Presence of stormwater retention facilities for sprinkler water, landscaping water, etc.				
DETAILS					
POINTS	3 (Evaluation Item)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				
RATING STANDARD	• Score = (Level-specific weight) × (Point) Points for installing a reservoir or basin on the site or building to retain stormwater and use it for sprinkling, landscaping, flushing, cleaning, etc. ※Rainwater tanks or rainwater storage containers included.				

Level	Stormwater retention facility capacity (m^3)	Weight
1	Stormwater retention facilities with a capacity of building area (m^2) × 0.05 or land area (m^2) × 0.02 or more	1.0
2	Stormwater retention facilities with a capacity of building area (m^2) × 0.03 or land area (m^2) × 0.01 or more	0.7
3	Stormwater retention facilities with a capacity of building area (m^2) × 0.01 or land area (m^2) × 0.005 or more	0.4

REFERENCE MATERIALS & SUBMISSION DOCUMENT

REFERENCE MATERIALS	* To be adjusted depending on the maturity of the relevant technologies, market conditions, and demand in Pakistan • Pakistani laws relevant or similar to the following: - Pakistan water code and enforcement rules including the installation of rainwater collection facilities and standards for rainwater collection facilities. - Rules for the determination, structure and installation standards for urban planning facilities. • Studies and guidelines related to the following: - Research on stormwater runoff reduction facility installation - Municipal stormwater retention facility installation guidelines
SUBMISSION DOCUMENT	- Drawings and capacity estimates for stormwater retention facility installation

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	C. Resource Efficiency			
	CRITERIA	C.4. Solid and Liquid Waste Management	**POINT**	6	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Promote the recycling of domestic waste by separating solid waste in domestic waste from the site.				
SDGs					
METHOD	Recyclable domestic waste storages and sorting of recyclables				
DETAILS					
POINTS	6 (Evaluation Item)				
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)				

RATING STANDARD

• Score = (Weight) x (Points Allocated)

Level	Separation of recyclable domestic waste	Weight
1	Installing a recyclable domestic waste storage Containers for at least 4 types of recyclable waste	1.0
2	Containers for at least 3 types of recyclable waste	0.7
3	Containers for at least 2 types of recyclable waste	0.4

※ Recyclable waste containers should be placed in a covered area to protect them from snow, rain, etc.

※Examples of recyclable domestic waste containers: bottles, metal cans, plastics, paper, scrap metal, fluorescent bulbs, used batteries, clothing, etc.

REFERENCE & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Laws stipulating the conservation of resources and the promotion of recycling Provisions on the storage of waste, separate collection of recyclable waste resources, etc.

SUBMISSION DOCUMENT	- Design drawings indicating the presence of domestic waste storage Design drawings indicating the installation of recyclable waste containers ※ Specifications may be used in lieu.

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	D. Indoor Environmental Quality			
	CRITERIA	D.1. Use of Low Indoor Air Pollutant Discharging Materials	**POINT**	9	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Encourage the use of materials that discharge less formaldehyde and volatile organic compounds, which can be released into indoor air from interior materials to have a direct adverse impact on residents.
SDGs	
METHOD	Use of low VOC materials
DETAILS	
POINTS	9 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Weighted average per floor based on sum of scores

Use of low indoor air pollutant discharging materials		**Coverage**	
		50%	**70%**
Application	Walls	0.5	1
	Ceilings	0.25	0.5
	Floors	0.5	1
	Adhesives	0.25	0.5

- Formaldehyde (HCHO) emissions < 0.015 mg/m2-h
- Total volatile organic compound (TVOC) emissions < 0.1 mg/m2-h
- Coverage levels based on the surface area

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- To be adjusted depending on the maturity of the relevant technologies, market conditions, and demand in Pakistan - Laws and enforcement rules on environmental technology and environmental industry support - Government standards for the appearance and quality of fiberboard for the construction industry, comparable to KS F 3200 in Korea

	- Pakistan's building indoor air quality process testing standards or similar legislation
SUBMISSION DOCUMENT	- Basic documentation - Indoor finishing materials list - Low VOC materials calculations - Supporting data for emissions

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	D. Indoor Environmental Quality			
	CRITERIA	D.2. Tobacco Smoke Control	**POINT**	1	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Prevent indoor air from being contaminated by tobacco smoke and supply fresh air into the indoor space to improve workers' health, productivity, and performance.
SDGs	
METHOD	Smoke-free building or smoke-free policy
DETAILS	
POINTS	1 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Sum of scores

Smoke-free building or smoke-free policy	Point
No smoking and smoke-free policy signs in the building	0.5
Separate smoking areas with separate air distribution units to allow for complete exhaust	0.5

- No smoking policy signs posted within 3 meters from the building entrance
- Separate smoking areas should be accompanied by a designated smoking area sign

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- This item can be modified or removed in consideration of local culture or conditions.

SUBMISSION DOCUMENT	- Basic drawings (non-smoking, smoking areas) - Smoke-free policy statement

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	D. Indoor Environmental Quality			
	CRITERIA	D.3. Natural Lighting	**POINT**	Residential: 6 Non-residential: 0	Evaluation Item
PURPOSE AND METHODS					
PURPOSE	Maximize the use of natural light to illuminate work surfaces and ensure a comfortable vision for residents.				
SDGs					
METHOD	Minimum natural light performance measured as average daylight factor (DF) and uniformity factor				
DETAILS					
POINTS	Residential: 6 (Evaluation Item) Non-residential: 0 (Evaluation Item)				
RATING TARGET	Residential Building : Entire Building (Including Community Centers)				
RATING STANDARD	• Score = (Weight) x (Points Allocated)				

Level	Average daylight factor (DF) and uniformity factor	Weight
1	Average DF ≥ 2.0%, uniformity factor ≥ 0.3%	2
2	Average DF ≥ 2.0%	1.6
3	Average DF ≥ 1.5% and < 2.0%	1.2
4	Average DF ≥ 1.0% and < 1.5%	0.8

- Average DF = Average work plane illumination indoors (Ei)) / Horizontal illumination on the roof at overcast sky (E0) x 100 (%)
- Uniformity factor = Minimum work plane illuminance (Emin) / Average work plane illuminance indoors at overcast sky (Eavg) x 100 (%)
- Average daylight illuminance averaged over 80% of the floor area and calculated for a height of 0.8 m from the floor surface
- Daylight illuminance as indoor light evaluation, calculated as the ratio of the average work plane illuminance indoors (Ei) to illuminance outdoors (E0) at the CIE overcast sky
- Uniformity factor as a measure of the homogeneity of light entering the space, calculated as the ratio of the minimum work plane illuminance (Emin) to the average work plane illuminance indoors (Eavg) at overcast sky

REFERENCE MATERIALS & SUBMISSION DOCUMENT

REFERENCE MATERIALS	-
SUBMISSION DOCUMENT	- Basic drawings (window design, etc.) - Natural daylight calculations - Simulation-related input conditions and results - (For implementation) Site photography

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	D. Indoor Environmental Quality			
	CRITERIA	D.4 Designated Areas to Rest and Refresh	**POINT**	Non-residential: 6	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Create dedicated break areas for customers or employees, allowing them rest and refresh themselves in a comfortable environment.
SDGs	
METHOD	Designated areas for building users (customers/employees) to rest and refresh
DETAILS	
POINTS	Non-residential 6 (Evaluation Item)
RATING TARGET	Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	• Score = (Weight) x (Points Allocated) ※Smoking areas excluded from dedicated resting areas.

Level	Dedicated resting area	Weight
1	Level 2 + Dedicated resting area (15 m2 or more) in the building for employees to rest and refresh (water or planting space may be installed in the resting area)	1.0
2	Dedicated resting area (15 m2 or more) in the building for customers to rest and refresh (water or planting space may be installed in the resting area)	0.7

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	-
SUBMISSION DOCUMENT	- Design drawings that include rest areas or water/planting areas

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	D. Indoor Environmental Quality			
	CRITERIA	D.5. Natural and Controlled Ventilation	**POINT**	8	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Provide controllable and fresh ambient air for occupants.
SDGs	
METHOD	Installation of windows and ventilation systems for residents to control to bring in fresh air
DETAILS	
POINTS	8 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	Weighted average per floor based on sum of scores Score = (Weight) x (Points Allocated) × Number of units applied / total units ※ Ratio of openable window area: Sum of openable window area / sum of floor area

Installation of ventilation devices or systems and the level of ventilation design	**Weight**
Openable window area ≥ 10% of floor area	1.0
Vents (including vent slots) per 20 m2 of perimeter boundary in heated or cooled space	1.0

Perimeter boundary: floor area up to 5 meters from the interior end of the exterior wall.

Controllable windows/vents: A mechanism or device installed on the wall, window frame, or window glass facing outdoors, which allows fresh air to be introduced without opening the window and the user to directly control the amount of ventilation or automatically opens and closes driven by factors such as humidity, CO2, etc.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Rules regarding the building facility standards in Pakistan - Materials on smoke elimination equipment

	- Smoke elimination window effective area calculation criteria
SUBMISSION DOCUMENT	- Detailed window design - Openable window area calculations

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	E. Post-Completion Green Building Actions			
	CRITERIA	**E.1.** Environmentally-friendly Space Planning and Management	**POINT**	2	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Promote green building by integrating green building design into the initial design stages.
SDGs	
METHOD	Building's green elements and engagement of green building certified professionals in design
DETAILS	
POINTS	2 (Evaluation Item)
RATING TARGET	Residential Building (Including Community Centers) Non-residential Building (Excluding Parking Lots, Mechanical Equipment Rooms, Electrical Rooms, etc.)
RATING STANDARD	Sum of scores

Environmentally-friendly space planning and management	Point
Site-specific signage about green building technologies and products	0.4
Presence of spaces to promote green building	0.4
Presence of a status board for renewable energy power generation, energy monitoring, etc.	0.4
One or more spaces that can be partitioned or consolidated using lightweight walls, dry walls, etc. to better utilize the space	0.4
Certified green building professionals' engagement in design	0.4

- Submit space utilization plans for spaces that can be partitioned or consolidated.
- Use Eco-label certified materials for lightweight walls, dry walls, etc.

※ Scoring for certified green building professionals' engagement in design

- Green building professionals who have completed relevant training in accordance with Article 21 of the Green Building Support Act and Article 8, Paragraph 3 of the Rules on Green Building Certification.

	- Certified green building professionals should provide knowledge on green building and engage in the design process to ensure that green building design is integrated into the early stages of building design.
REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	-
SUBMISSION DOCUMENT	- Photography of installed products - Green building professionals' qualification documents - Proof of certified green building professionals' engagement

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	E. Post-Completion Green Building Actions			
	CRITERIA	**E.2.** Construction Site Environment Management	**POINT**	2	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	To create a green construction site, evaluate eco-friendly activities in and around the site and site management activities to minimize environmental impact.
SDGs	
METHOD	Contractors' ISO 14001 (Environmental Management System) certification, environmental management policy, and the establishment and implementation of environmental management plans for the construction site.
DETAILS	
POINTS	2 (Evaluation Item)
RATING TARGET	Outdoor Space of Residential, Non-residential Buildings
RATING STANDARD	Score = (Weight)×(Point)

Level	Construction site environment management	Weight
1	The contractor has ISO 14001 certification, an on-site environmental management organization based on ISO 14001, and an environmental management plan.	1.0
2	The contractor has an internal operation policy that prioritizes the environment, an on-site environmental management organization, and an environmental management plan.	0.8
3	The construction site has a documented environment management plan, an organization to implement that plan, and an environmental management plan.	0.6
4	The construction site has an organization to implement environment management and an environmental management plan.	0.4

- The environmental management plan should be established separately from the environmental management organization at the headquarters or on site. It should specify matters related to the environmental management organization and tasks required for the construction of the building to be certified.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Construction Technology Promotion Act, Ministry of Land, Infrastructure, and Transport

	- Construction Environmental Management Standard Specifications, Ministry of Land, Infrastructure, and Transport - Sustainable Management Academy website (http://www.ksasma.or.kr), Korean Standards Association - ISO 14001 (Environmental Management System)
SUBMISSION DOCUMENT	- ISO 14001 certificate - Contractor's environmental management policy - Site environment management plan ※ Application plans can be used in lieu. - Construction site environment management report - Photography as proof of documents submitted

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	E. Post-Completion Green Building Actions			
	CRITERIA	E3. Operation and Maintenance	**POINT**	3	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Prepare information on the operation of building facilities and equipment (including electronic documents) and provide the users with manuals to ensure that the building operates at maximum efficiency and is maintained as initially intended.
SDGs	
METHOD	Provision of necessary documentation for the management of the building, the operation and maintenance of its facilities and equipment, and user manuals in the electronic document formats that are accessible through an information processing system.
DETAILS	
POINTS	3 (Evaluation Item)
RATING TARGET	Residential Building, Non-residential Building
RATING STANDARD	Sum of scores

Level	Operation/maintenance documentation and manuals	Point
1	Level 2 + 8 of operation/maintenance documentation and manuals	3.0
2	Level 3 + 7 of operation/maintenance documentation and manuals	2.0
3	Level 4 + 6 of operation/maintenance documentation and manuals	1.0
4	Necessary documentation + 1-5 of operation/maintenance documentation and manuals	0.5

Necessary documentation
(1) As-built drawings (architectural, structural, mechanical, electrical, fire, landscape, civil engineering, etc.) (2) As-built documents (geological survey reports, structural calculations, specifications, etc.) (3) Periodic inspection documents as per the periodic inspection list (periodic inspection manual based on the Detailed Guidelines for Safety Inspection and Precision Safety Diagnosis)
Operation/maintenance documentation and manuals

	(1) Roof waterproofing maintenance manual (2) Building structural and non-load-bearing wall maintenance manual (3) Operation and maintenance manuals for heating and cooling sources and hot water systems (4) Operation and maintenance manuals for elevators, exterior lighting, CCTVs, and parking control facilities (5) Maintenance manuals for lighting facilities and lighting fixtures (6) Landscaping maintenance manual (7) Maintenance manuals for water supply and drainage facilities (including stormwater and gray water) (8) Maintenance manual to prevent condensation in underground parking lots and common areas (9) Maintenance manuals for renewable energy facilities (10) Maintenance manuals for fire protection and fire suppression facilities - The building operation and maintenance manual should include the following: - Current status, inspection methods, regular maintenance checks, cautionary notes for managers, inspection cycles, maintenance personnel contact information, etc.
REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Building Design Document Standards, Ministry of Land, Infrastructure, and Transport - Building Maintenance Inspection Manual, Ministry of Land, Infrastructure, and Transport - Detailed Guidelines for Safety Inspection and Precision Safety Diagnosis, Korea Infrastructure Safety Corporation
SUBMISSION DOCUMENT	- Necessary documentation for operation and management - Operation and maintenance manuals ※ Application plans can be used in lieu. - Confirmation of the provision of manuals - Photography as proof of the provision of documents

	PAKISTAN GREEN BUILDING CODE				
	CATEGORY	E. Post-Completion Green Building Actions			
	CRITERIA	E.4. Monitoring	POINT	1	Evaluation Item

PURPOSE AND METHODS	
PURPOSE	Encourage operations management to reduce carbon dioxide emissions, energy and water consumption to maintain building performance and reduce costs.
SDGs	
METHOD	Continuous monitoring and management plans for energy, water consumption, and air quality data throughout the building lifecycle.
DETAILS	
POINTS	1 (Evaluation Item)
RATING TARGET	Residential Building, Non-residential Building
RATING STANDARD	Sum of scores

Level	Monitoring	Point
1	Separate space for monitoring operations and an operation plan	0.5
2	Providing users with energy and water consumption monitoring data	0.5

- Monitoring information as provided through devices that display and allow for control of necessary information, such as smartphone applications or wall pads, or devices installed in common areas such as shared entrances, elevator rooms, etc.
- An operation plan should include maintenance and performance management plans and energy saving measures.

REFERENCE MATERIALS & SUBMISSION DOCUMENT	
REFERENCE MATERIALS	- Building Energy Saving Design Standards, Ministry of Land, Infrastructure, and Transport - Smart Home Network Installation and Technology Standards, Ministry of Land, Infrastructure, Transport and Ministry of Trade, Industry and Energy
SUBMISSION DOCUMENT	- Monitoring and management space drawings - Monitoring and management operation plans, handover plans, and other relevant manuals ※ Application plans can be used in lieu. - Documentation and photos as proof of installation and features of monitoring and management devices

	- On-site photography

Quick Questionnaire Survey for Pakistan Green Building Code

Greeting from KICT(Korea Institute of Civil Engineering and Building Technology). We are public research institute in Korea and we are proceeding the research project for Pakistan Green Building Code developing. The project is supported by UN CTCN(Climate Technology Cooperation and Networks). And Pakistan Green Growth Consulting is cooperation partner for this project.

We are conducting a survey to understand the awareness and necessity of green building certification in Pakistan.

This survey aims to gather your awareness, experiences, and opinions about green building certification to inform the development of future green building policies and programs in Pakistan. Additionally, we are interested in understanding your professional background and expertise to better contextualize the responses. Your valuable insights will significantly contribute to fostering a sustainable building culture in your country.

The survey will take approximately 10 minutes to complete,

We appreciate your participation and request your honest feedback.

Your answers will be used strictly for statistical purpose.

Please take time out of your busy day to respond to our survey. Thank you.

Survey holder: National Green Building Center of KICT

Contact: ssm1216@kict.re.kr

■ [Consent to the collection and use of personal information]

1. **Purpose of the collection and use of personal information:** Personal information collected through the survey will be used only for the purpose of data analysis and report preparation.
2. **Collected personal information items:** We are collecting data that requires consent from individuals whose personal information is being collected and used according to Article 15 of the Personal Information Protection Act of the Republic of Korea.
3. **Period of possession and use of personal information:** Collected personal information will be destroyed immediately after the analysis of survey responses.
4. **You may refuse to consent to our collection and use of personal information.** Only those individuals who consent to provide their personal information can take part in the survey

Section 1: Personal Information

1. **Name (e-mail):**
    - ☐ _____
2. **Gender:**
    - ☐ Male
    - ☐ Female
    - ☐ Other
    - ☐ Prefer not to say
3. **Age Group:**
    - ☐ Under 18
    - ☐ 18-24
    - ☐ 25-34
    - ☐ 35-44
    - ☐ 45-54
    - ☐ 55-64
    - ☐ 65 and above
4. **Occupation:**
    - ☐ Student
    - ☐ Architect
    - ☐ Engineer
    - ☐ Builder/Contractor
    - ☐ Government Official
    - ☐ Environmental Consultant

- ☐ Real Estate Developer
- ☐ Other (please specify): _____

5. **Years of Experience in Relevant Occupation:**
   - ☐ Less than 1 year
   - ☐ 1-3 years
   - ☐ 4-6 years
   - ☐ 7-10 years
   - ☐ More than 10 years
6. **Areas of Interest:**
   - ☐ Energy Efficiency
   - ☐ Sustainable Materials
   - ☐ Water Conservation
   - ☐ Indoor Air Quality
   - ☐ Waste Reduction
   - ☐ Renewable Energy
   - ☐ Green Building Certifications
   - ☐ Other (please specify): _____

Section 2: General Awareness of Green Building Certification

1. How familiar are you with the concept of green building certification?
   - ☐ Very familiar
   - ☐ Somewhat familiar
   - ☐ Not very familiar
   - ☐ Not familiar at all
2. Have you ever been involved in a project that aimed for green building certification?
   - ☐ Yes (please specify): _____
   - ☐ No
3. How important do you think green building certification is for Pakistan's future?
   - ☐ Very important
   - ☐ Important
   - ☐ Somewhat important

- ☐ Not important

4. What do you think are the main benefits of green building certification? (Select all that apply)
   - ☐ Environmental sustainability
   - ☐ Energy savings
   - ☐ Healthier indoor environment
   - ☐ Long-term cost savings
   - ☐ Enhanced property value
   - ☐ Other (please specify): _____

Section 3: Understanding of Pakistan's Nationally Determined Contributions (NDC)

1. How familiar are you with Pakistan's Nationally Determined Contributions (NDC) under the Paris Agreement?
   - ☐ Very familiar
   - ☐ Somewhat familiar
   - ☐ Not very familiar
   - ☐ Not familiar at all
2. Do you believe that Pakistan's NDC targets are achievable?
   - ☐ Yes
   - ☐ No
   - ☐ Not sure
3. In your opinion, how important is the role of green building certification in achieving Pakistan's NDC targets?
   - ☐ Very important
   - ☐ Important
   - ☐ Somewhat important
   - ☐ Not important

Section 4: Participation in the Development of Pakistan's Green Building Code (Appendix 1)

1. Have you ever participated in the development of Pakistan's Green Building Code?
   - ☐ Yes
   - ☐ No
2. If yes, in what capacity did you participate? (Select all that apply)

- ☐ Policy maker
- ☐ Consultant
- ☐ Architect/Engineer
- ☐ Industry representative
- ☐ Academic/Researcher
- ☐ Other (please specify): _____

3. How would you rate your overall experience with the development process of the Green Building Code?
    - ☐ Very positive
    - ☐ Positive
    - ☐ Neutral
    - ☐ Negative
    - ☐ Very negative

Section 5: Agreement with the Composition of Pakistan's Green Building Code

1. How strongly do you agree with the current components of Pakistan's Green Building Code?
    - ☐ Strongly agree
    - ☐ Agree
    - ☐ Neutral
    - ☐ Disagree
    - ☐ Strongly disagree
2. Which components of the Green Building Code do you find most effective? (Select all that apply)
    - ☐ Energy Efficiency
    - ☐ Water Conservation
    - ☐ Sustainable Materials
    - ☐ Indoor Air Quality
    - ☐ Waste Reduction
    - ☐ Renewable Energy
    - ☐ Other (please specify): _____
3. What improvements or additions would you suggest for the Green Building Code?
    - ☐ _____

Section 7: Opinions on the KICT-Developed Green Building Certification for Pakistan

1. Are you aware of the green building certification system currently being developed by the Korea Institute of Civil Engineering and Building Technology (KICT) for Pakistan?
    - ☐ Yes
    - ☐ No
2. What concerns or challenges do you foresee with the implementation of the KICT-developed certification in Pakistan? (Select all that apply)
    - ☐ High implementation costs
    - ☐ Lack of local expertise
    - ☐ Compatibility with existing regulations
    - ☐ Industry resistance
    - ☐ Other (please specify): _____

3. Do you have any suggestions or recommendations for the KICT team to consider in the development of the green building certification system for Pakistan?
    - ☐ _____

Thank You for Participating

Thank you for taking the time to participate in this survey. Your insights and feedback are invaluable in shaping the future of green building practices in Pakistan.

Please submit your responses by June 21. Following this, there will be a second survey focused on the draft version of the Pakistan Green Building Code developed by KICT. Your continued participation will be greatly appreciated.

Thank you once again for your valuable contribution.

Sincerely yours,

KICT National Green Building Center

Appendix 1: Proposed section for the Pakistan Green Building Code

(Reference: Vision 2030 for a Green Building Code in Pakistan, switchasia, 2022, Annex 2 Process and institutional set-up for a Green Building Code in Pakistan, Table 7)

A- Site Planning & Development
1. Site Sustainability : Land Use Rules & Zoning Regulations 2. Building Orientation 3. Heat Island Mitigation 4. Green Planning and Design : Building Design Criteria and Construction Standards 5. Effctive Land and Space Use : Integrated Design and Green Buidling Concentration / Landscaping and Stormwater Drainage Requirements
B- Gren Building Construction
6. Building Materials Sustainability 7. Building Envelope and Openings : Climate Zones and Prescriptive Building Envelope 8. Natural and Controlled Ventilation 9. Fire Safety 10. Roof Insulation
C- Resource Efficiency
11. Water Efficiency 12. Rainwater Harvesting 13. Energy Efficiency : Performance Option for Energy Efficiency and Insulation / Precriptive Equipment Efficiency Tables for Alternate and Increased Efficiency 14. Solid and Liquid Wastes Management : Deconstruction and Construction Debris(voluntary and regulatory) / Waste Recovery and Recycling
D- Post-Completion Green Building Action

15. Environemtal Pre-requisties and Assessment : Minimum Green Building Requirements
16. Buidling Inspection & Commissioning : Guidance for GB Functional Performance Testing and Commissioning Process
17. Green Building Code Compliance Rating : Green Building Efficiency and Sustainability Measures
18. Post-Occupation O&M Considerations

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