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A Critical Analysis of Institutional and Regulatory Framework for Building Stock Energy Efficiency and Transition in Pakistan

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Abstract

Climate change has emerged as a global focal point, notably affecting vulnerable countries like Pakistan. The country faces heightened risk, prompting concern among many due to its susceptibility to climate-related hazards. An imperative challenge arising from this phenomenon is the necessary shift towards sustainable energy, particularly concerning energy consumption within the building sector. Buildings significantly contribute to daily energy usage and subsequent GHG emissions. In Pakistan, transitioning to energy-efficient building stock holds pivotal importance in mitigating climate change impacts. This hinges on establishing a robust institutional framework and regulatory structure centered around energy efficiency. While Pakistan possesses policies and national guidelines advocating for energy-efficient buildings, their practical enforcement and application remain inadequate. The inception of the Building Energy Code of Pakistan in 1990, based on ASHRAE 90.1 standards, marked a step forward. However, obstacles rooted in institutional weakness and limited capacity building have impeded its effective adoption and adherence. Although the Energy Provisions of 2011 introduced modifications, their scope remained confined mainly to commercial structures. This paper conducts an extensive assessment of Pakistan's existing institutional and regulatory framework for building energy efficiency and transition. Drawing on literature insights and stakeholder perspectives, an in-depth understanding of prevailing policies and institutions uncovers underlying reasons for non-compliance and limited implementation. Additionally, input was gathered from stakeholders through interviews, aiming to identify barriers obstructing the reinforcement of building energy efficiency measures in Pakistan. Discourse and narrative analysis, informed by literature and stakeholder interviews, revealed the significance of awareness, participation, coordination, capacity building, technical expertise, finance, and resources as key factors contributing to deficient compliance and implementation of existing codes and policy guidelines. This paper also proposes actionable recommendations to expedite the transition towards a sustainable, energy-efficient building stock in Pakistan.

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Keywords

Energy efficiency; Building stock; Building code; Institutional framework; Regulatory framework; Stakeholders perspective

1. Introduction

Globally buildings are a significant energy consumer, accounting for about 40% of the world's energy consumption and 33% of GHG emissions (IEA, 2019; Ali. et al., 2019). With an estimated 15.7 MtCO2 emissions (83 kg CO2 per capita) in 2017, buildings operation in Pakistan accounts for about 30% of total emissions and is growing at annual

growth rates of 4.7% and 2.5% in the domestic and commercial sectors, respectively (UNDP, 2019). In developed countries, residential buildings consume the majority of energy, whereas in developing countries, residential, commercial, and institutional buildings all consume energy (Javed et al., 2016). Among the many factors, HVAC systems contribute significantly to the energy use of a building alongside degrading the environment (ASHRAE, 2001; Zheng et al., 2011). This has raised concerns regarding energy efficiency among many all around the globe (Pylse & Kalema, 2008). New concepts and approaches for example zero energy, positive energy districts, zero carbon, and carbon neutrality have, thus, emerged to address the issue of inefficient energy use of buildings (Parker, 2009; Chen, 2021; Seto et al., 2021; Derkenbaeva et al., 2022). Several other studies have also been done with respect to different regions for reducing energy consumption in buildings and making them energy efficient (Brøgger & Wittchen, 2018; Uihlein & Eder, 2010; Attia et al., 2022). Transitioning to energy-efficient building stock is a crucial step in lowering total energy demand, and greenhouse gas emissions as well as combating climate change. A study by the International Energy Agency reveals that the transition to energy-efficient buildings based on sustainable heating and cooling systems could reduce CO2 emissions from buildings by 80% by 2050 as well as reduce energy consumption (IEA, 2019). In order to achieve this it is important to have a stable and well-structured institutional and regulatory framework that entails sound policies and plans toward sustainable building stock.

Rapid urbanization in developing countries has increased energy use and CO2 emissions in the building sector (IEA, 2017), and these emissions have caused Pakistan's average temperature to rise by 0.6 to 1 degree Celsius (Ministry of Climate Change, 2017). In Pakistan, about 30% of the national electricity (ADB, 2017) is attributed to buildings. Between July 2017 and February 2018, the residential sector in Pakistan accounted for 51% of the country's total electricity consumption. Figure 1 presents a clear picture of this in this regard.

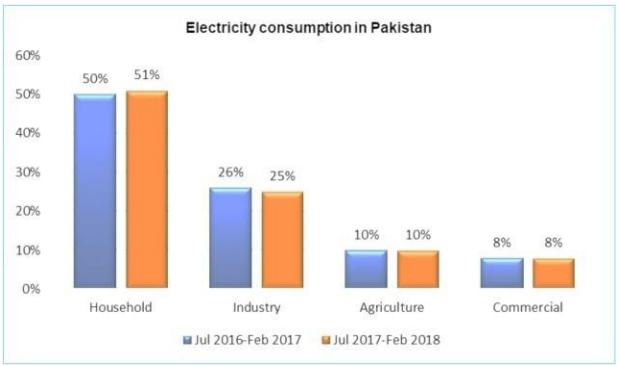

Figure 1: Electricity consumption in Pakistan (MoF, 2018)

To address these concerns, a strengthened institutional backbone is essential for providing the necessary policy framework, capacity-building opportunities, financing mechanisms, coordination and collaboration, and monitoring and evaluation systems to ensure that energy efficiency goals are effectively pursued and attained (Afzal et al., 2021). Several organizations and government bodies in Pakistan develop and implement policies and programs regarding energy efficiency in buildings as part of the institutional framework for building energy efficiency in Pakistan. The diversity of building types, ranging from traditional constructions to modern high-rises, poses a unique challenge in devising strategies that cater to this wide spectrum. Despite notable efforts to promote energy efficiency in buildings, Pakistan faces several challenges that hinder the effective implementation of energy-saving measures and sustainable building practices (Young, 2018; Ali, Imran & Ali, 2018; Ali & Khursheed, 2021). According to the existing literature, diverse views regarding the energy system of Pakistan are found (Asif, 2009; Sheikh, 2010; Rauf, Wang, Yuan, & Tan, 2015). There is a whole series of papers examining the challenges which hinder the development of energy-efficient building stock in Pakistan (Bhutto, Bazmi, & Zahedi, 2011; Bhutto, Bazmi, & Zahedi, 2012; Bhutto, Bazmi, & Zahedi, 2012b; Bhutto, Bazmi, & Zahedi, 2013; Abbas, et al., 2014). These studies also highlight the various constraints including financial, technical, energy planning, capacity building, and governance in way of energy efficient framework. Pakistan also faces significant policy mistakes which become a key barrier to sustainable development in Pakistan (Rafique & Rehman, 2017).

This study aims to analyze and assess the existing institutional framework for building energy efficiency and transition in Pakistan. It will delve into the roles and responsibilities of various organizations and government bodies, examine

the current building codes and standards, and evaluate the effectiveness of policies and programs that have been implemented. By addressing the outlined challenges and gaps, this research seeks to provide insights and recommendations that can guide the enhancement of Pakistan's institutional framework for energy efficiency and promote a more sustainable and energy-efficient building stock, contributing to both national energy security and global climate goals.

This paper is aimed at analyzing the existing institutional framework of building stock energy efficiency and transition in Pakistan to achieve the following study objectives:

- To identify the Pakistani institutions and regulatory framework responsible for implementing building energy efficiency codes and policies
- To evaluate the existing building energy efficiency codes and policies in promoting building energy efficiency
- To identify the obstacles in adopting building codes and policies for devising ways to overcome these constraints
- To examine the role of stakeholders in promoting energy efficiency in building construction in Pakistan

This research relies primarily on the existing literature and past studies to analyze the institutional and regulatory framework of energy efficiency in building stock in Pakistan. It is based on an extensive assessment of Pakistan's existing institutional and regulatory framework for building energy efficiency and transition. Drawing on literature insights and stakeholder perspectives, an in-depth understanding of prevailing policies and institutions uncovers underlying reasons for non-compliance and limited implementation. Additionally, input is gathered from stakeholders through interviews, aiming to identify barriers obstructing the reinforcement of building energy efficiency measures in Pakistan. Hence, based on discourse and narrative analysis, the key factors contributing to deficient compliance and implementation of existing codes and policy guidelines have been identified.

2. Literature Review:

Institutional and Regulatory Framework

The following section will explain in detail the institutional and regulatory framework for buildings' energy efficiency and transition that exists in Pakistan.

2.1. Institutional Framework

Pakistan has several key institutions involved in promoting energy efficiency (UNDP, 2018). The Pakistan Engineering Council (PEC) is in charge of developing and implementing building codes and standards, such as the Building Energy Code (BEC). The Ministry of Energy (MoE) formulates and implements energy policies and programs, including those about efficient buildings. The National Energy & Conservation Authority (NEECA) promotes and implements energy efficiency and conservation measures in all economic sectors, including buildings (Maher et al., 2019). At the provincial level, energy departments implement energy policies and programs, while municipalities and building departments enforce energy-efficient building codes and standards at the local level.

The following section will talk in detail about these current key institutions for energy efficiency and transition in the country.

2.2. Pakistan Engineering Council (PEC)

PEC was founded in 1976 (PEC & ENERCON, 2011) and is primarily responsible for accrediting engineering programs, regulating the engineering profession, and registering engineers, firms, and consultants. In addition, it coordinates with the other national institutes for the establishment of scientific standards applicable to the country. One of the Council's major accomplishments is the creation of the BEC of Pakistan, associated standards, implementation, and enforcement at various levels. Moreover, PEC has the authority to make modifications to these standards as and when necessary. They collaborate with various stakeholders, such as the engineering community, government bodies, and academia, to develop and implement engineering standards and practices-related policies. Additionally, PEC solicits public feedback on a variety of issues via its website and social media platforms.

2.2.1. National Energy Efficiency and Conservation Authority (NEECA)

In 2016, ENERCON which was the National Energy Conservation Centre became the National Energy NEECA (ENERCON, 2001). The authority prepares energy conservation plans and programs in major energy consumption sectors of the country. It also formulates policies alongside implementing and monitoring energy-related works which are catered by different public and private sectors. Simultaneously, it also conducts training programs for knowledge exchange and implementation guidance for its policies as well as practices. The Energy Efficiency and Conservation Act of 2016 gave NEECA the authority to develop and implement policies as well as programs regarding energy efficiency in various sectors as well as buildings. Through inspections and audits, NEECA has the authority to enforce the BEC (ENERCON, 2001). It may also impose penalties on building owners who do not adhere to the code's energy efficiency standards and guidelines.

2.2.2. Ministry of Energy (MoE)

MoE creates and executes energy policies and programs (Ministry of Energy, 2022), and is primarily responsible for developing and implementing policies pertinent to the production, transmission, and distribution of energy in Pakistan. It also develops policies for renewable and alternative energy sources, including solar & wind as well as hydropower. The Ministry also coordinated with other government agencies, including the National Electric Power Regulatory Authority (NEPRA), the National Energy Efficiency and Conservation Authority (NEECA), and the Alternative Energy Development Board (AEDB). MoE also plays a positive role in spreading awareness among the public regarding energy conservation and efficiency measures. It has also, collaboratively, played a role in developing the BEC and has also launched an initiative titled "Pakistan Energy Star" to promote energy-efficient appliances and equipment.

2.2.3. Punjab Energy Efficiency & Conservation Agency (PEECA)

The PEECA is the pioneer among the provincial agencies on energy efficiency and has the role of overseeing plans and policies regarding the subject within the Punjab province. Established in 2016, PEECA played an effective role in modifying the BEC in the context of the Punjab. The Agency has also held various workshops in Lahore, Rawalpindi, and Multan to ensure energy efficiency. It also focuses on building compliance ways and tools applicable within the provincial context. The Punjab Energy Efficiency Building Code (PEEBC), as well as the Punjab Energy Efficiency and Conservation Program, have been taken up for implementation by the Agency to ensure energy-efficient building stock (PEEC). It also oversees the design and construction of buildings.

2.2.4. Pakistan Green Building Council (PGBC)

This is a non-profit organization that works under the World Green Building Council umbrella to promote sustainable building design practices (SDPI, 2018). Although PGBC has little to do with the formulation of policies and plans, it promotes the significance of sustainable building construction and design among the general public. The Council was able to draft Pakistan's first Green Building Guidelines, namely SEED, in 2016, which was published in October 2016 but not made available for public use (Sustainability in Energy and Environmental Development). SEED is concerned with how buildings (of all types) and communities are planned, constructed, and maintained but targets only new construction (PGBC, 2020). In connection with this, PGBC launched a building rating system in 2016 that has gained immense popularity in the Green Building industry and has been successfully implemented throughout Pakistan. This is known as the SEED certification, and several workshops and training programs have been conducted to raise awareness. The certification evaluates the structure based on various sustainability parameters, after which points are assigned. The buildings are awarded the rating level Gold, Silver, Platinum, and Titanium based on their points which get totaled based on various design and construction parameters (Liu et al., 2010). Although PGBC's operations appear promising, its influence over the formulation and implementation of codes and policies is questionable and weak.

2.2.5. Local Authorities and Departments

In the BEC (EP-2011), the local authorities were given the Authority Having Jurisdiction (AHJ). This assigned them the role of granting planning permission, and preparing building codes, to ensure local development and policy implementation. Despite this, it has been observed that the majority of these authorities lack technical and skilled

personnel who can comprehend existing plans and proposals. Typically every metropolis in Pakistan has a development authority, for example, The Lahore Development Authority (LDA) looks into the aforementioned work (LUMS, 2017) in Lahore. Although their role in planning and development at an urban scale remains satisfactory, there is a significant gap in performing energy efficiency and conservation tasks.

2.3. Regulatory Framework

The regulatory framework, on the other hand, consists of energy efficiency codes, policies, and provisions developed in Pakistan to promote energy conservation and efficiency. A review of these initiatives reveals that significant efforts have been made to improve energy efficiency, although the implementation of these policies and provisions remains difficult. The following sections will provide a detailed insight into the different building energy codes and policies.

2.3.1. Building Energy Code of Pakistan (BECP)

The National Energy Conservation Centre, also known as ENERCON, in 1990 was the pioneer in developing Pakistan's Building Energy Code. Its most recent version came out in 2018. This is a revised version of the ASHRAE 90.1 standard and entails minimum performance standards for buildings in terms of energy efficiency (ASHRAE, 2013). The BEC only covers commercial structures and does not take into account the residential requirements as laid out in ASHRAE standard 90.2. Climate is another important parameter kept in consideration.

2.3.2. The 2011 Energy Provisions

The year 2011 saw a new development as the BEC of Pakistan received a modification in terms of the Energy Provisions (PEECA, 2020). Because the PEC (Pakistan Engineering Council) is responsible for reviewing as well as approving building regulations, it approved these energy provisions in 2011 which was published in 2013 within the Building Energy Code Pakistan (ENERCON, 1990). These new provisions provided a framework for architects, engineers, and contractors to improve energy efficiency in building stock in Pakistan. It is also a guided resource for building owners and managers seeking to implement energy-efficient techniques and minimize energy usage in their structures. It is an essential policy instrument for promoting sustainable building practices and reducing greenhouse gas emissions in Pakistan's building sector. The primary objective of these regulations is to establish minimum criteria for the design and construction of energy-efficient buildings. These provisions are based on the ASHRAE 90.1 standard from 2004, whereas the Building Envelope part is designed with consideration for local environmental circumstances and the energy codes of other regional nations. Figure 2 below summarizes the institutional hierarchy and associated policies & plans in Pakistan.

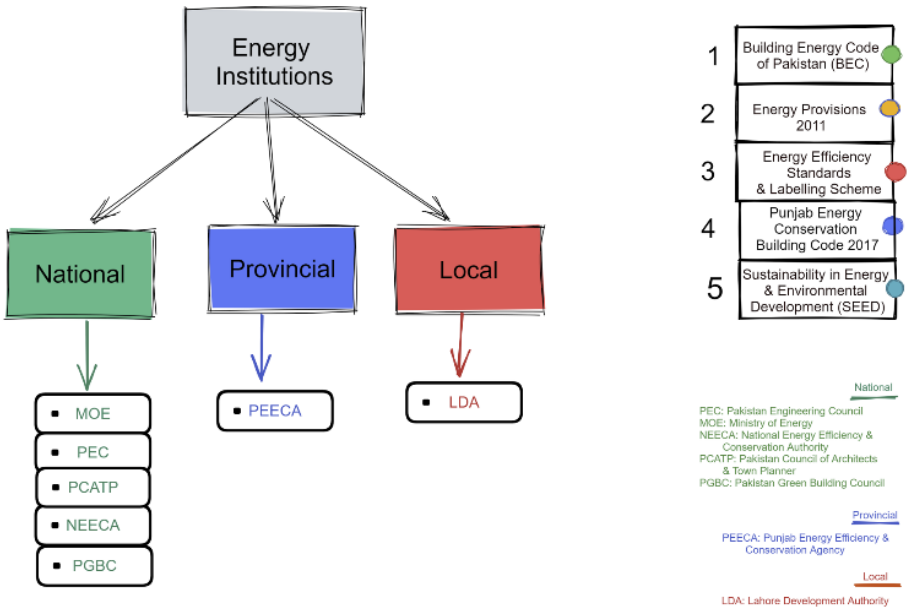

Figure 2 Institutional hierarchy and associated policies and plans

3. Stakeholders' Perspective

Stakeholders' perspective plays a significant role in identifying the roles, needs, and expectations of different organizational players for enhancing energy efficiency in buildings and for their better management. Interviews with stakeholders from MoE, NEECA, PEECA, PEC, and LDA held as part of this research, gave insight into the current situation regarding building stock energy efficiency, and helped identify the missing gaps and prospects for future planning. The officials from these authorities were asked to participate in a semi-structured interview, either physically in person, or virtual over the phone or online (Teams/Zoom/Skype), with a duration of about 20 - 30 minutes. The responses gathered from the stakeholders of different organizations have been briefly summarized in Table 1 below.

Table 1 Stakeholders' Interview Response

Sr. No.	Name of Organization	Type of Organization	Response
1	Ministry of Energy (MoE)	National	▪ Works closely with NEECA to promote energy efficiency and conservation in different sectors including buildings ▪ Adhere to BECP, and ECBC, and provide financial incentives for energy-efficient buildings ▪ Performs costs & benefits analysis for energy-efficient measure ▪ Evaluate the feasibility and effectiveness of different energy-efficient solutions ▪ Holds a multi-pronged approach to address the economic, technical, institutional, and behavioral barriers to energy efficiency in buildings ▪ involved in raising awareness and capacity building, providing financial incentives, promoting technology development and adoption, and improving the regulatory framework
2	National Energy Efficiency & Conservation Authority (NEECA)	National	▪ Follows primarily BECP and takes guidance also from international standards ▪ The present code and provisions mostly meet the requirements of new commercial buildings. The residential and retrofitting of the old stock – "We still are behind the track". ▪ As per the law the codes/provisions need to be revised every 3 to 5 years, but most of the time this is not possible due to a lack of data and institutional barriers ▪ At all institutional levels compliance with the code and policies must be strictly followed but unfortunately, due to political and several vested interests, this is been overlooked ▪ Knowledge regarding energy-efficient building stock is lacking among the individuals. ▪ Over the past we have seen serious energy crises and buildings have been a key contributor to that. If awareness is not being raised, it is feared that the country might end up seeing another major crisis
3	Punjab Energy Efficiency & Conservation Agency (PEECA)	Provincial	▪ BECP forms the foundation of PEECA ▪ Ensures that all new buildings meet the minimum standard requirements ▪ Works in close coordination with NEECA and Punjab's other departments, but capacity building is an issue ▪ Every province has a different climate, but for Punjab, it is quite challenging as summer is harsh and so is the winter. So planning is a tricky ▪ Spread of awareness among different companies and individuals through workshops and trainings

			▪ Installation of solar panels is, although going high in Lahore, but still it is important to curtail energy consumption ▪ PEEC provides Standardization and Labelling of electrical appliances for adopting minimum energy performance standards ▪ Work is also going on establishing an "Air Conditioning Unit Testing Lab", to reduce the energy deficit nationally ▪ The newly launched "Powerscourt mobile app" is another way to cope with the issue of high energy use
4	Pakistan Engineering Council (PEC)	National	▪ Formulated the BECP and monitored it as well as the associated policies ▪ However, a lack of the right skills causes delay in assessment ▪ Energy efficiency cannot be achieved without considering all types of buildings, but unfortunately, it is that residential and old buildings still lack the right standards ▪ Works in close connection with other consultants, operators, and companies to ensure their work, but the right expertise and tools in energy-efficient building stock is a drawback
5	Lahore Development Authority (LDA)	Local	▪ Ensures that all new building plans are approved and passed after going through a thorough assessment that involves the minimum requirements of the energy efficiency standards ▪ For old buildings not much can be done except to raise awareness to bring a change in lifestyle and willingness to adopt energy-efficient measures ▪ Due to the vested interests of the people and political influence, the issue of approval without the assessment is being faced ▪ Building construction in Lahore is quite unsustainable and the element of energy-efficient design is missing. This can be followed for new construction but challenging for the existing ones ▪ Place-specific plans and policies are missing, the formulation of which will the implementation of sustainable design easy

4. Discussion and Findings

The discourse & narrative assessment based on the literature and stakeholder interviews identified several obstacles toward energy-efficient building stock in Pakistan.

5. Barriers

The building stock in Pakistan is diverse, and while there have been efforts to promote energy efficiency in buildings, the transition also faces several challenges based on the literature findings and stakeholders' perspectives.

- Lack of awareness and capacity building*: T*his is partially attributable to the lack of comprehensive training programs and certification processes for building professionals. Many politicians, building owners, and construction professionals lack an understanding of the benefits of energy efficiency, as well as the technical knowledge and skills necessary to adopt energy-efficient techniques. As a result, they often do not prioritize energy efficiency in their building projects.
- Inadequate regulatory framework*:* Pakistan's regulatory framework for building energy efficiency is deficient, with minimal mandated building energy efficiency criteria. In addition, there is a lack of enforcement measures to ensure compliance with current requirements. Building owners and managers have little incentive to invest in energy-saving technology or adapt existing structures to increase energy efficiency. The public is generally unaware as well.
- Limited financing and incentives: There are not many incentives for builders and owners to engage in energy efficiency measures. Typically, energy-efficient technology and construction materials are more expensive than their conventional counterparts, which might dissuade builders and developers from adopting them. Without

accessible financing and incentives, the move to an energy-efficient building stock would be sluggish and constrained.

- Inadequate monitoring and evaluation: There is a lack of in-depth data regarding the energy performance of buildings in Pakistan, which makes it difficult to track progress and assess the impact of energy efficiency policies and programs. Without effective monitoring and evaluation, it is challenging to measure the impact of energy-efficient building initiatives on energy consumption, greenhouse gas emissions, and other key indicators.
- Limited human resources*:* There is a lack of specialists skilled in planning, constructing, and renovating energy-efficient buildings. This deficiency might hinder the implementation of energy-efficient building techniques and technology. In addition, building professional training programs in Pakistan frequently lack information on energy-efficient construction methods and technology.
- Lack of coordination*:* Various institutions may have competing aims and objectives, resulting in uncertainty and a lack of clarity over the appropriate course of action. This can result in inefficient resource allocation, including duplication of efforts, waste of resources, and delays in the implementation of energy-efficient building programs. Ineffective coordination between institutions can also result in inadequate policy execution, undermining the efficacy of energy-efficient building regulations and diminishing the impact of energy-efficient building efforts.

5.1. Needed Steps to a Working Institutional and Regulatory Framework

To solve these difficulties, a concerted effort including all relevant parties is necessary. This research focuses on strengthening the institutional capacity, enforcement of existing standards, increasing stakeholder engagement, and developing a futuristic strategy pertinent to energy efficiency and building stock in Pakistan. The need to have a central institutional body is pivotal for the effective working of plans and policies. This central body must have the required resources and skillset to not only enforce the standards but also to oversee any modifications. Moreover, imposing penalties and strict fines for non-compliance with the standards is also a much-needed step. However, this may require an independent regulatory body that can supervise the aspect of compliance strictly. In addition, knowledge sharing and spreading awareness among stakeholders as well as the public is of prime importance, as they must be informed well regarding energy-efficient buildings. This may take place through training programs, awareness campaigns, and several other outreach activities. Also, finances must be adequately made available to involve contemporary technological practices towards sustainable construction and development. One possible way to accomplish this could be the provision of tax incentives, grants, or loans to building owners and developers to foster energy-efficient practices. Nevertheless, to address the shortcomings of Pakistan's institutional setup in terms of building stock energy efficiency and transition would need a determined effort from the government, the private sector, and the society. This will emphasize developing effective policies, capacity building, and participation.

6. Conclusion

Pakistan offers enormous potential for energy savings and greenhouse gas reduction through energy-efficient building techniques and technologies, as its construction industry is a major energy user. Yet, institutional and regulatory barriers have impeded the development of energy-efficient construction practices and technologies in the country. To encourage the shift to energy-efficient building stock in Pakistan, a regulatory framework is necessary. There are inadequacies in the institutional legal and regulatory structure, which hinder the implementation of energy-efficient plans and regulations. The Energy Conservation Act of 2016 and the Building Energy Code of 2011 offer a stabilized framework for energy efficiency in buildings, however implementation and enforcement gaps exist. Ineffective enforcement measures, for instance, contribute to low compliance with energy efficiency regulations. Moreover, the institutional environment for energy efficiency is fragmented, with several agencies and departments responsible for various areas of energy efficiency. This fragmentation produces a lack of coordination and coherence, making it difficult to execute policies and programs that promote energy efficiency efficiently. In terms of building design and construction procedures, there are also problems on the technological front. Several buildings in Pakistan are constructed without regard for energy efficiency, and the design and construction sector lacks understanding and skills in this area. This ignorance frequently results in an emphasis on aesthetics rather than energy efficiency. On the technical front, there is a need for more education and training for designing and constructing energy-efficient

buildings. This might entail providing training programs for construction experts and encouraging the use of energy-efficient technology through finance mechanisms and tax incentives. To construct a solid framework for energy-efficient building stock in Pakistan, all provinces, local authorities, and line departments must be on board, as the execution of policies is largely institution-dependent. Lack of technical competence and ineffective tools are further obstacles to the implementation of the code and rules. Training, workshops, and skill development can contribute to a deeper grasp of the topic. Only institutional capacity building and a transparent atmosphere will make this feasible.

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