

ORIGINAL RESEARCH ARTICLE

Rethinking green finance for sustainable transportation in Pakistan: Institutional barriers, policy misalignments, and pathways for climate-compatible mobility

Hamza Iftikhar^{1†*}, Ume Laila Shah^{1†}, Sumera Iqbal^{1,2}, Atiqah Binte Fayyaz³, and Rana Sakandar Hayat⁴¹Department of Government and Public Policy, Jinnah School of Public Policy and Leadership, National University of Sciences and Technology, Islamabad, Pakistan²Bahira Business School, Bahira University, Islamabad, Pakistan³Department of Climate and Energy, World Wide Fund for Nature Pakistan, Lahore, Punjab, Pakistan⁴Riphah Institute of Public Policy, Riphah International University, Islamabad, Pakistan

Abstract

This study examines the role of green finance in advancing sustainable transportation in Pakistan through a qualitative case study approach. As transportation increasingly affects climate mitigation, urban liveability, public health, and smart mobility transitions, the need for context-specific financing solutions has become more urgent in developing countries. The study draws on semi-structured interviews with 10 stakeholders from government, finance, academia, civil society, and transport-related institutions, supported by secondary analysis of policy documents and relevant literature. Thematic analysis identified four major themes: institutional barriers, policy misalignments, financing mechanisms and gaps, and global lessons for adaptation. The findings show that although Pakistan has made progress in developing a regulatory architecture for green finance through green bond guidance, Green Sukuk initiatives, and climate-related financial reforms, this progress has not yet translated into a coherent transport-focused financing ecosystem. Institutional weakness, fragmented federal–provincial governance, weak project-preparation capacity, and poor alignment between transport and financial policy continue to constrain implementation. The study further finds that financing needs are sector-specific and that instruments such as green bonds, green sukuk, blended finance, and public–private partnerships must be tailored to different transport subsectors. The study concludes that Pakistan requires a phased, context-sensitive strategy that aligns institutions, policies, and financial tools to support sustainable transportation and its broader benefits for health, urban liveability, and smarter mobility systems.

Keywords: Green finance, Sustainable transportation, Climate finance, Urban mobility

[†]These authors contributed equally to this work.

***Corresponding author:**Hamza Iftikhar
(hiftikhar@jsppl.nust.edu.pk)

Citation: Iftikhar H, Shah UL, Iqbal S, Fayyaz AB, Hayat RS. Rethinking green finance for sustainable transportation in Pakistan: Institutional barriers, policy misalignments, and pathways for climate-compatible mobility. *Asian J Water Environ Pollut*. 2026;23(3):026060033. doi: 10.36922/AJWEP026060033

Received: February 7, 2026**Revised:** March 23, 2026**Accepted:** April 14, 2026**Published online:** May 28, 2026

Copyright: © 2026 Author(s). This is an Open-Access article distributed under the terms of the Creative Commons Attribution License, permitting distribution, and reproduction in any medium, provided the original work is properly cited.

Publisher's Note: AccScience Publishing remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

1. Introduction

Transportation has moved to the forefront of modern debates on climate change, urban growth, and public well-being, as mobility systems affect not only emissions but also air quality, congestion, accessibility, and the overall liveability of cities. Recent scholarship

is calling for a rethink of transport policy, which should be developed as an integral part of a wider urban systems agenda in which cleaner mobility contributes to healthier and more resilient cities. Empirical research from dense urban environments also provides evidence of links between traffic-related pollution and substantial health burdens, which have only added to the perception that sustainable transportation is a public-health and city-development imperative, not a technical transport problem.¹

In Pakistan, these concerns are acute. Rapid urbanization, increased motorization, reliance on imported fuels, and the indiscriminate expansion of public transport have increased demand for cleaner and more efficient mobility systems. The challenge lies not just with technology. Sustainable transportation demands substantial and long-term investment in public transit modernization, electric mobility, charging infrastructure, and integrated urban transport.² Consequently, the shift to sustainable transportation is highly dependent on the availability of suitable financing mechanisms and the ability of public institutions to implement policy ambition into bankable projects.

Green finance has become a key global mechanism for channeling capital into environmentally sustainable sectors, including transport. Instruments such as green bonds, green sukuk, blended finance, and public-private partnerships (PPPs) are increasingly discussed as means to facilitate low-carbon mobility transitions. Pakistan has also made some efforts to develop an official green finance architecture. The Securities and Exchange Commission of Pakistan (SECP) issued official Green Bond Guidelines in 2021.³ Some of the more recent developments include the government initiatives toward sovereign domestic Green Sukuk and the continued development of climate-related financial frameworks, including the Pakistan Green Taxonomy. These initiatives point toward green finance becoming institutionalized in Pakistan, but do not yet indicate a mature transport finance ecosystem.

The transport sector is a perfect example of this gap. Pakistan's policy direction on electric and new-energy vehicles has become more ambitious, but their implementation remains limited. The finalized New Energy Vehicles (NEV) Policy 2025–2030 recognizes the failure of the 2019 policy to meet its targets and sets a new target of 30% of new vehicle sales by 2030. This points to an important policy shift and serves as a marker of how far policy intent and sectoral transformation remain. The mere existence of policy targets is not enough to guarantee the provision of financing pathways for electric public transport, charging systems, or smart urban mobility

infrastructure.⁴

A further challenge is that the literature tends to discuss green finance instruments in broad, descriptive terms, without adequately exploring their operational aspects within the specific institutional and governance structures in Pakistan. In reality, different transport subsectors require different financing models. Large public transport projects may be better suited to green bonds or green sukuk, whereas EV charging infrastructure, fleet conversion pilots, and smart mobility systems may require blended finance, concessional support, or carefully structured PPPs. Their feasibility depends on the clarity of regulations, institutional coordination, project preparation capacity, and the overall maturity of financial markets.⁵

The relevance of international experience also has to be interpreted with caution. Case studies such as Norway, the Netherlands, Shenzhen, and India offer a good chance to learn from, but successful transport transitions in those areas were aided by enabling conditions, including strong institutions, fiscal capacity, developed capital markets, and integrated urban governance. Even in institutionally stronger contexts, as we know from research, sustainable transport policy can be subject to significant tensions in implementation, including the contradiction between sustainability objectives and actual investments.⁶ Consequently, global best practices are useful to Pakistan only if they are adopted as a source of selective adaptation rather than direct replication.

This study addresses the role of green finance in achieving sustainable transportation in Pakistan using a qualitative case study approach. It focuses on the feasibility, barriers, and policy relevance of green bonds, green sukuk, blended finance, and PPPs in the context of transport and the governance environment of Pakistan. This study adds to the literature in three ways. First, it contextualizes green finance to the real needs of Pakistan's transport sector rather than discussing it at a general level of climate policy. Second, it examines the roles that institutional weakness, policy misalignment, and federal-provincial fragmentation play in financing feasibility. Third, it links sustainable transportation finance to broader issues of urban liveability, health, and smarter mobility systems, framing them as a multidimensional development challenge rather than a narrow funding problem.

2. Literature review

2.1. Conceptual background of green finance and sustainable transportation

Green finance generally describes financial flows, instruments, institutions, and policies that support

environmentally sustainable activities, including climate mitigation, climate adaptation, resource efficiency, pollution reduction, and ecosystem protection. In practical terms, it refers to mechanisms such as green bonds, green loans, sustainability-linked sukuk, blended finance, concessional climate funds, and environmental, social, and governance (ESG)-aligned investment frameworks.⁷ The critical role of green finance is to align capital allocation with sustainability goals by stimulating investment in sectors that deliver environmental benefits while minimizing ecological risks. Within the context of public policy, green finance also plays a coordinating role, bridging the gap between environmental objectives, banking systems, capital markets, public investment planning, and private-sector participation.

Sustainable transportation, similarly, is not limited to the narrower goal of curbing transport emissions. It refers to environmentally responsible, socially inclusive, economically viable, and institutionally resilient transport systems. Such systems aim to reduce pollution, improve energy efficiency, and enhance access and mobility for different populations. They are part of more integrated urban planning. Recent scholarship has established that mobility transitions are closely related to the development outcomes of cities, especially health, liveability, and the broader smart city agenda. Tonne *et al.*⁷ highlighted that healthy, sustainable urban development requires an understanding of the interdependence between urban systems and human well-being. Mak and Ng⁸ showed that traffic pollution has clear spatial and health implications in dense urban environments. Likewise, Modarelli *et al.*⁹ demonstrated that sustainable and smart mobility is not only affected by infrastructure but also by public attitudes, governance decisions, and social acceptance. These insights imply that transport policy cannot be considered in isolation but must be connected to broader urban and development outcomes. The literature on healthy urban development, traffic pollution and its health impacts, and smart mobility always stresses these interconnections.

The conceptual relationship between green finance and sustainable transportation is that sustainable mobility transitions are capital-intensive and institutionally demanding. Public transport modernization, fleet electrification, charging infrastructure, smart traffic systems, non-motorized transport networks, and transit-oriented development all require sustained investment. Consequently, it is not possible to decarbonize transportation solely through policy directives. The financial architecture is equally important because the scale, timing, and risk structure of transport investment determine whether low-carbon mobility solutions can

translate policy intentions into implementation. Thus, sustainable transportation is not just a technological or environmental challenge; it is also a financial and governance challenge.

2.2. Global literature on green finance instruments

The international literature identifies a number of major financing instruments relevant to environmentally sustainable transitions, including sustainable transportation. Among the most prominent are green bonds, green sukuk, blended finance, PPPs, and concessional or climate fund financing. Green bonds are a type of debt instrument that is raised to finance capital for environmental benefit projects. Their international growth has made them one of the most visible tools in sustainable finance. In the transport sector, green bonds are frequently linked to large-scale infrastructure projects, such as rail modernization, electric public transport, transit infrastructure, and urban mobility systems.⁵ Their main strength is their ability to mobilize long-term capital and attract institutional investors. However, their effectiveness is based on the existence of credible standards, transparent reporting, project pipelines, and issuers with adequate financial credibility.

Green sukuk is an adaptation of green debt financing in Islamic finance. It has a similar function to green bonds but is designed to comply with Shariah principles. Their relevance is especially great in Muslim-majority environments or financial systems, where Islamic finance has a strong presence. From a transport perspective, green sukuk can help support climate-compatible infrastructure while expanding the investor base. Their advantage lies in normative and financial compatibility in some markets, but their expansion still depends on regulatory clarity, project certification, and the overall maturity of Islamic capital markets.

Blended finance refers to the effective use of concessional or public capital to catalyze private investments for projects that may otherwise be considered too risky or not sufficiently profitable. This approach is especially useful for early-stage sustainable transport investments, such as electric vehicle (EV) charging networks, smart mobility pilots, and urban fleet conversion projects, for which commercial returns may be uncertain at the outset.⁹ The literature often presents blended finance as a way to reduce investment risk and improve bankability, particularly in developing countries where markets are shallow and first-mover risks are elevated.

Public-private partnerships are another major instrument discussed in the literature. PPPs can be pertinent to sustainable transportation initiatives when

governments lack the necessary public funds and wish to involve the private sector in delivering, maintaining, or providing services. They are useful for transport terminals, charging networks, fleets, and integrated mobility services.¹⁰ However, the literature is also clear that PPPs are highly sensitive to governance quality, contract enforcement, regulatory predictability, and political continuity. Finally, concessional climate finance and climate funds remain important for countries facing fiscal or market constraints. Such financing can help support transport projects with a high environmental value but with low commercial attractiveness. However, the international literature also states that the amount of concessional funding received is insufficient unless countries can prepare credible projects and incorporate them into domestic policy and financial systems.

Together, these instruments show that financing sustainable transportation is not dependent on a single model. Rather, different projects need different instruments depending on project size, risk, maturity, governance setting, and market development. The implementation literature also makes clear that policy ambition is not enough to ensure transport transition.

2.3. Green finance progress in Pakistan

A major achievement was the issuance of the SECP Guidelines for Green Bonds in 2021, which provided an official framework for issuing green bonds and sukuk in line with international principles.¹¹ This stage marked the formal legal recognition of sustainable finance in Pakistan's capital market. The guidelines were prepared to encourage financing of projects with environmental benefits and to align Pakistan's regulatory approach with global green finance norms.

The State Bank of Pakistan (SBP) has also played a growing role in advancing the green financial agenda. Recent official reporting has shown that some of the climate-related works of SBP include the *Green Banking Guidelines*, the *Environmental and Social Risk Management Implementation Manual*, and the development of the Pakistan Green Taxonomy with the Ministry of Climate Change.¹² These developments indicate that climate-related financial governance issues are gradually becoming more systematic in the banking and regulatory system. At the same time, according to official reporting, Pakistan's financial system is also structurally constrained, with limited market depth, and the banking system is not yet fully oriented toward large-scale climate-aligned investment.¹³ This is significant, as sustainable transportation requires long-term, coordinated, and technically appraised

investment structures rather than short-term financing.

A further indication of progress was Pakistan's move toward a sovereign domestic Green Sukuk in 2025. Official briefings from the Ministry of Finance and the Pakistan Stock Exchange outlined the first issue as a major step toward aligning domestic financial markets with green finance goals, with the program designed to finance environmentally sustainable projects. This initiative is relevant especially as it provides a link between climate-oriented finance and the country's well-established Islamic finance ecosystem. However, while such developments are a sign of forward movement, they do not guarantee that Pakistan has already established a mature green finance market. Rather, they show that Pakistan is still in a stage of framework formation and a very early stage of market signaling.

2.4. Financing gaps in sustainable transportation in Pakistan

The transport sector is a case in point for the limits of this progress. Pakistan's previous National Electric Vehicle Policy cited transport emissions, energy dependence, and industrial opportunities as key reasons to support EV adoption. More recently, the NEV Policy 2025–2030 has sought to fast-track this transition by tying cleaner mobility to industrial and environmental goals and explicitly emphasizing the integration of public transport. However, policy ambition seems to outpace implementation. Official announcements on the NEV policy recognize the need to transform Pakistan's transport sector; however, the presence of policy targets has yet to filter into a fully developed transport–finance ecosystem capable of supporting electrified fleets, charging corridors, and integrated mobility systems at scale.

Despite the development of a green finance architecture, significant financing gaps remain in Pakistan's transportation sector. These gaps are apparent in both traditional mass transit and new modes of mobility, such as EVs, charging infrastructure, shared mobility, and smart transport technologies. The challenge of financing is not just about having enough money, but also about misalignment between instruments and sectoral needs.⁸ High-capital projects, such as rail modernization, metro projects, and bus rapid transit (BRT) expansion, require long-term financing, public guarantees, and stable intergovernmental coordination. By contrast, EV charging networks, municipal fleet conversion, and intelligent mobility platforms often require smaller, riskier, and more innovation-focused financing mechanisms. Pakistan has not yet fully developed a differentiated financial architecture to match these different transport needs with

the right funding tools.

This financing deficit has broader implications for city development as well. Underinvestment in sustainable transportation has not only implications for emissions and congestion, but also impacts air quality, public health, and urban liveability. Tonne *et al.*⁷ showed that traffic-related pollutant emissions are linked to substantial health burdens in high-density urban areas. Raihan and Sarker⁶ showed that sustainable urban development and human well-being are deeply interconnected. In a Pakistani context, this means that inadequate funding for cleaner mobility will have the opposite effect, furthering pollution exposure, mobility inequality, and inefficient urban form. Likewise, in scholarship on smart mobility, it is emphasized that, in the future, transport systems will be more connected through digital coordination, public trust, and intelligent infrastructure rather than mere vehicle replacement. These broader links make a stronger case for analyzing transport finance as a city development issue rather than a narrow infrastructure problem.

Pakistan's financing deficit is also influenced by excessive reliance on traditional public funding and donor-specific project funding. Without better domestic mechanisms, sustainable transport finance tends to be fragmented, episodic, and reliant on isolated policy initiatives. This leaves the sector exposed to the risk of implementation delays, changing political priorities, and inconsistent provincial uptake. Consequently, the financing deficit in Pakistan is not just a lack of resources; it is the lack of a coherent transport-specific green finance pipeline to facilitate sustained mobility transformation.

2.5. Domestic vs. international barriers

2.5.1. Domestic barriers

Domestic barriers to green finance in Pakistan include weak institutional capacity, fragmented federal-provincial coordination, limited technical expertise in preparing green projects, shallow capital markets, and weak alignment of environmental goals with transport planning. These barriers matter because sustainable transportation projects require credible planning, technical appraisal, coordination across agencies, and investor confidence. Even when national-level policies exist, implementation may stall if institutions lack the capacity to draft cohesive project proposals, structure appropriate financing, or ensure continuity across political and bureaucratic cycles.¹⁴

Another domestic constraint is the limited operational integration between financial sector reforms and transport-sector policy. Although Pakistan has introduced green finance guidance and climate-related financial measures,

translating these developments into transport investment remains incomplete. Transport, environmental, industrial, and financial policies still appear insufficiently coordinated. This fragmentation makes it harder to translate policy intentions into bankable projects and may weaken investor perceptions of project credibility.¹⁴

2.5.2. International barriers

International barriers differ in form but interact with domestic weaknesses. These include dependence on concessional or donor-linked funding, complex compliance requirements for climate-finance access, external investor concerns about governance and implementation risks, and limited domestic capacity to efficiently absorb international capital.⁸ In practice, the existence of global green finance opportunities does not automatically benefit Pakistan if domestic institutions cannot structure projects to meet technical, fiduciary, and environmental requirements.

The interaction between domestic and international barriers is especially important. External financing may be available, but if domestic agencies lack project-preparation capacity or intergovernmental coordination, those funds may not translate into sustained transport outcomes. As a result, Pakistan's sustainable-transport financing problem is dual: it is constrained by both internal institutional weaknesses and the difficulty of converting international financial opportunities into locally embedded and scalable transport investments.

2.6. Global best practices and relevance for Pakistan

International examples from countries or cities such as Norway, the Netherlands, Shenzhen, and India are often presented as models of sustainable mobility and transport decarbonization. These cases are useful because they demonstrate how policy incentives, financial mechanisms, and planning coordination can support mobility transitions.¹⁵ However, the literature also makes clear that successful cases are deeply shaped by context. This implies that global examples should not be treated as plug-and-play solutions for countries with different fiscal and governance realities.

The relevance of global best practice for Pakistan, therefore, lies in selective adaptation, not direct imitation. Pakistan differs from many successful international cases in terms of fiscal capacity, market depth, municipal autonomy, infrastructure readiness, and bureaucratic coordination. For example, policies that depend on deep capital markets or strong municipal borrowing institutions may be less immediately transferable. By contrast, phased transition frameworks, targeted public incentives, blended-risk financing models, and stronger integration

between transport planning and climate policy may be more adaptable.

Global smart-mobility literature also reinforces the need for contextualization. Mark and Ng⁸ emphasized that public attitudes, social controversy, and governance structures shape the success of alternative transport systems. Malik *et al.*¹⁰ highlighted the importance of transparency, trust, and explainability in technologically advanced mobility environments. These insights matter for Pakistan because they suggest that mobility transitions require institutional and social legitimacy, not only financial or technological capacity. In this sense, the main lesson from global practice is that financing tools work best when embedded within coherent institutions, stable policies, and socially accepted urban strategies.¹⁵

For Pakistan, the most relevant transferable lessons are likely to include phased transport-finance strategies, risk-sharing arrangements for emerging green projects, clearer policy coordination between financial and transport authorities, and stronger linkage between sustainable mobility and city-level health and liveability goals. What is less transferable without adaptation are models built on mature capital markets, highly autonomous local governments, or consistently strong enforcement systems. Thus, global best practice is useful for Pakistan only when interpreted analytically and adjusted to local conditions.

2.7. Research gap

The literature shows that green finance has gained substantial conceptual and regulatory importance globally and is increasingly visible in Pakistan through green bond guidance, climate-related financial supervision, green taxonomy efforts, and sovereign Green Sukuk developments. It also shows that sustainable transportation is closely linked to broader urban concerns, including air quality, health, liveability, and smart-city development. At the same time, the literature indicates that sustainable transport transitions are difficult to implement, even in stronger governance settings, because policy ambitions often encounter institutional, political, and social barriers.

However, an important gap remains in the Pakistan-specific literature. Existing discussions tend either to focus broadly on climate finance or to address transportation policy without examining in depth how green finance instruments can be operationalized for sustainable transportation. There is still limited analysis of how instruments such as green bonds, green sukuk, PPPs, and blended finance fit Pakistan's specific transport needs; how domestic and international barriers interact; how institutional weakness and policy misalignment reinforce

one another; and how global lessons can be adapted rather than simply copied.

This study addresses that gap by examining green finance for sustainable transportation in Pakistan through a qualitative case-study lens. It focuses not only on the availability of green finance instruments but also on their feasibility, institutional constraints, policy relevance, and sector-specific applicability. In doing so, it contributes a more grounded understanding of how sustainable transportation can be financed in Pakistan's actual governance and financial context, while also linking the issue to wider concerns of urban liveability, health, and smart mobility. Pakistan's recent policy and market developments make this question timely, but the literature still lacks sufficient context-specific analysis of how those developments can be translated into workable transport-finance pathways.

3. Methodology

3.1. Research design

The current study adopted an exploratory qualitative design, grounded in the sparse literature on green finance for sustainable transportation in Pakistan, especially from the perspectives of actors involved in policy formulation, financial mechanisms, and implementation processes. This questioning approach helped identify emergent patterns, explanatory hypotheses, and stakeholder-based relationships. Furthermore, the design allowed for an in-depth interpretative analysis of the understanding of financial instruments, including green bonds, green sukuk, blended finance, and PPPs, vis-à-vis the transport sector and governance milieu in Pakistan.

3.2. Data collection

Primary data were collected through semi-structured interviews with stakeholders identified for their demonstrable knowledge, institutional position, and relevance to the research question. A semi-structured interview was chosen because it offered a balance between methodological consistency and flexibility for the interviewer. All study participants were asked about shared themes, but the format was flexible enough to probe issues such as institutional fragmentation, policy misalignment, lack of financing, and implementation barriers. Each interview took 35 to 60 min and was held in person or online, depending on the participant's availability and accessibility. The interview agenda focused on the current status of green finance in Pakistan, sector-specific financing requirements in transportation, institutional and regulatory challenges, and the applicability of international best practices to the Pakistani context.

The interviews were complemented by secondary data collection. The study examined peer-reviewed journal articles, government policies, climate finance, and transport sector documents and institutional publications relevant to sustainable transportation and green finance in Pakistan. These sources were used to contextualize stakeholder responses, identify the current policy directions, and examine the national trajectory and constraints of green finance instruments. Secondary materials also supported triangulation by allowing comparative analysis of interview evidence with policy or documentary evidence.

3.3. Sampling strategy and participants

Purposive sampling, supplemented with convenience-based access as needed, was used to identify participants with direct experience or expertise in green finance, climate policy, transport planning, sustainable mobility, and institutional governance. This purposive approach was justified by the empirical need for informed subjects rather than a statistically representative sample. Selection criteria included professional involvement in policymaking, financial sector expertise, sustainable transport practice, and environmental governance or research congruent with the topic.

Participants came from across the spectrum of institutional perspectives, including government ministries, provincial transport departments, financial sector organizations, academia, international development institutions, non-governmental organizations, and sustainable transport organizations. This multi-stakeholder composition was designed to ensure there would be no single-sector bias and to provide a more rounded picture of the institutional, financial, and policy challenges affecting green finance in Pakistan's transport sector. For ethical reasons and to maintain confidentiality, participants were assigned codes rather than their actual names, while their stakeholder categories and institutional level were maintained to highlight the extent of participation.

The interview participants, as per [Table 1](#), represented a diverse set of institutions involved in climate finance, sustainable mobility, transport governance, environmental regulation, and development planning. Their inclusion enabled the study to capture a multi-stakeholder understanding of the institutional, financial, and policy challenges affecting the adoption of green finance for sustainable transportation in Pakistan.

3.4. Data analysis

Thematic analysis of interview data was performed. The study used an inductive coding scheme to allow themes to

emerge organically from the data. The analytic procedure was carried out in several distinct steps: first, the interview transcripts were repeatedly read to gain familiarity and identify recurring ideas and patterns; second, meaningful text segments were assigned initial descriptive codes related to such issues as policy inconsistency, financing gaps, regulatory constraints, institutional weakness, donor dependence, transport infrastructure needs, and the relevance of international examples; third, similar codes were grouped into broader categories; and, finally, these categories were refined through iteration and comparison until they coalesced into the major themes presented in the findings section.

The resultant thematic framework grouped the findings into four main domains: institutional barriers, policy misalignments, financing mechanisms and gaps, and global lessons and best practices. The analysis was considered iterative, with themes refined throughout as the researcher moved between transcripts, coded segments, and secondary materials. To increase transparency in the analysis process, representative excerpts from interviews are included in Section 4 as examples of how participants' perspectives helped shape each theme.

3.5. Validation and trustworthiness

Given the qualitative nature of the study, the credibility of the findings was strengthened through trustworthiness measures rather than statistical validation. First, data triangulation was used by comparing interview evidence with policy documents, academic literature, and institutional reports. Second, contributions from individuals with diverse institutional backgrounds reduced the risk of sector- or organizational-specific bias. Third, coding was conducted systematically, with repeated reading and comparative analysis of responses to identify consistent patterns across participants. Fourth, an attempt was made to achieve analytical transparency by relating results to recurrent stakeholder views and confirming documentary evidence.

To reduce the bias inherent in purposive and convenience sampling, the research did not focus on a single category of respondents but sought to include as many perspectives as possible from federally and provincially based government actors, financial experts, researchers, civil society representatives, and developmental-oriented institutions. This heterogeneity ensured that the analysis corresponded to different perspectives rather than a particular institutional narrative. Ultimately, the goal of the study is depth of understanding, not statistical generalization, consistent with qualitative case study research.

Table 1. Profile of interview participants

Participant code	Stakeholder category	Institutional affiliation	Level
AW	Government policymaker	Ministry of Climate Change	Federal
MI	International organization representative	Climate finance program, international development agency	International
HJ	Financial sector expert	Green finance specialist, banking sector	National
DB	Academic researcher	University researcher in climate policy and sustainable transport	National
YD	NGO representative	Environmental NGO working on mobility and climate action	National
SL	Transport policy expert	Sustainable transport organization	National
AK	Government official	Provincial Transport Department	Provincial
FR	Financial regulator, policy expert	State Bank of Pakistan/financial regulatory domain	Federal
NM	Public sector development expert	Ministry of Planning/Infrastructure Planning Unit	Federal
BI	Public sector head	Ministry of Human Rights	Federal

Abbreviation: NGO: non-governmental organization.

3.6. Ethical considerations

Confidentiality was ensured through the use of participant codes rather than names and by reporting stakeholder identities only within generalized institutional categories. Participation was voluntary, informed consent was obtained from all participants, and interview data were used for academic purposes only. The use of coded identifiers protected the respondents while still allowing the manuscript to reflect the study's diverse perspectives. Ethical approval for this study was obtained from the S3H Ethics Committee, National University of Sciences and Technology.

4. Results

This section describes the findings of the thematic analysis of semi-structured interviews with government, academic, civil society, and international organization stakeholders. An analysis revealed key views on the practical challenges and enablers to promoting green finance in the Pakistani transportation sector. There were four core themes extrapolated from the data: institutional barriers, policy misalignments, financing mechanisms and gaps, and global lessons and best practices. The themes highlighted

the interplay among governance structures, the degree to which a country is financially prepared for sustainable transport, and policy coherence that shapes the trajectory of sustainable transport development. To ground these themes, the discussion below integrates direct stakeholder insights with evidence to show how they are implicated in Pakistan's transition to climate-compatible mobility.

4.1. Theme 1: Institutional barriers

A finding that stands out in the study is the presence of institutional weakness as a major barrier to mobilizing green finance for sustainable transportation in Pakistan. Limitations in bureaucratic capacity, technical expertise, project preparation, inter-agency coordination, and implementation continuity were repeatedly stressed by participants. These weaknesses dampen public institutions' capacity to identify viable, sustainable transport projects, structure them in financially credible ways, and attract domestic or international green capital. This finding is important because sustainable transportation projects do not require only general policy support. They need institutions that can prepare bankable proposals, coordinate environmental and transport goals, and manage long-term implementation across a number of actors. In

Pakistan, these institutional demands are particularly high because transport governance involves federal-level ministries; provincial-level departments, regulators, and development agencies; and city-level transport bodies. Where coordination mechanisms are weak, financing opportunities may go underutilized despite policy ambitions.

“There is [a] lack of capacity in financial institutions to design and implement green finance projects, creating further hurdles in accessing international climate funds,” AW noted. MI added, “Policy fragmentation between federal and provincial governments further exacerbates the challenges, leading to delays and inefficiencies.” HJ emphasized, “A lack of accountability and monitoring mechanism[s] to ensure that the green finance policies are effectively implemented is observed.” These reflect the pervasive regulatory weakness and enforcement gaps within institutional structures. AK also noted, “Bureaucracy involved in approving green finance project is characterized by long delays, which discourages investors.”

In the transport sector specifically, these institutional weaknesses manifest in several concrete ways. Provincial transport departments often lack the technical expertise to structure green financing models for bus fleet electrification, metro expansion, or EV charging infrastructure. Similarly, coordination gaps between transport authorities and financial regulators delay the integration of climate finance mechanisms into urban mobility planning. For example, while EV policy targets may be announced at the federal level, provincial transport agencies responsible for implementation frequently lack access to concessional financing tools or structured green credit lines. This sector-specific disconnect impedes the operationalization of green finance in transport projects and slows the transition to low-carbon mobility systems.

Cross-sector inefficiencies were also highlighted. YD noted, “Green finance requires a multi-stakeholder approach, but in Pakistan, the lack of coordination between government agencies, private sector actors, and civil society remains a major challenge.” Similarly, DB remarked, “There is a significant knowledge gap among policymakers and financial institutions regarding the structuring of green finance projects.” These interviews support the findings of Naqvi *et al.*¹⁶, who argued that developing countries require institutional strengthening to enable effective deployment of green finance.

4.2. Theme 2: Policy misalignments

The second major theme concerns the misalignment of policies across transport, climate, and financial governance. Participants suggested that Pakistan’s policy

landscape is currently fragmented and lacks integration between environmental ambitions, transport planning, and financing strategies. Although there are policies such as the EV framework and green finance guidelines, they do not seem to be integrated into a common implementation architecture. This tenuous alignment leaves issues such as priorities, responsibilities, and financing pathways unresolved.

This finding suggests that Pakistan’s challenge is not only a lack of policy but also a lack of policy coherence. Sustainable transportation calls for a coordinated framework in which the planning of the transport sector, environmental objectives, industrial incentives, and financial instruments mutually reinforce one another. However, when such domains evolve independently from each other, this creates inconsistent implementation. For example, an electrification policy for transport would be good, but unless accompanied by appropriate fiscal incentives, regulatory clarity, charging infrastructure plans, and financing mechanisms, it will remain aspirational rather than operational.

“The absence of green finance clauses in most national policies indicates a lack of foresight in addressing sustainability,” BI noted. HJ pointed out, “Disjointed policies between federal and provincial governments create barriers to implementing green finance effectively.” DB further emphasized the problem, stating, “Sustainable transport policies must prioritize electrification and renewable energy integration to attract global funds.” SL added, “These are steps in the right direction, but implementation remains a significant hurdle.”

Several participants criticized the implementation of the EV policy. According to BI, “Due to [a] lack of clear and consistent policies, it is difficult to connect green finance projects with international funding requirements.” HJ observed, “Policy fragmentation delays progress in sustainable transport systems.” This aligns with the findings of Guo *et al.*¹⁹, who stated that strategic decarbonization in Southeast Asia succeeded because transport and finance policies were jointly restructured to enable financing for low-carbon systems.

4.2.1. Interplay between institutional barriers and policy misalignment

The findings show that institutional barriers and policy misalignments are not separate challenges but are mutually reinforcing dynamics. Limited technical capacity within financial institutions limits the inclusion of green finance clauses in the design of transport policy. At the same time, fragmented federal/provincial governance structures undermine policy coherence through inconsistent

implementation frameworks, further weakening institutional capacity. For example, the lack of clarity in regulatory requirements was cited as a factor delaying project approvals, thereby acting as a disincentive to private-sector involvement and institutional learning.

This interaction between weak institutional capacity and poorly aligned policies creates a feedback loop: weak institutional capacity reinforces poorly aligned policies, and poorly aligned policies reinforce weak institutional capacity. Rather than functioning as isolated constraints, institutional fragmentation and policy incoherence combinedly hinder the creation of a coordinated green finance ecosystem for sustainable transportation in Pakistan. Addressing one dimension without reforming the other is therefore unlikely to be systemically improving.

From a governance perspective, institutional weaknesses, such as low bureaucratic capacity, weak regulatory mandates, and limited inter-agency coordination, make the state less able to devise cohesive green finance policies. When technical expertise in financial structuring is lacking, transport policies are drafted without financial and integrated financing mechanisms, leading to policy misalignment. Furthermore, weak accountability and monitoring frameworks undermine implementation discipline and lead to inconsistent enforcement of EV targets and incentive structures. On the other hand, misaligned policies create ambiguity about roles and responsibilities, further burdening the already-constrained institutional capacity. This reciprocal relationship is path-dependent, often seen in public policy systems, as a weak institutional foundation and fragmented policy design reinforce each other in a circular pattern over time, thereby constraining the effectiveness of reform.

4.3. Theme 3: Financing mechanisms and gaps

The third theme relates to the limited use of green finance tools and the ongoing large financing gaps in the Pakistan transportation sector. Participants clearly understood the relevance of mechanisms such as green bonds, green sukuk, blended finance, and PPPs, but also highlighted that these have not been successfully adapted to the country's transport requirements. The problem is thus not a lack of instruments per se, but a lack of ability to adapt and implement them in context-specific ways.

Green bonds and green sukuk were generally seen as promising for large-scale public transport schemes, particularly when sovereign support, regulatory certainty, and visible environmental benefits could facilitate investor confidence. However, participants also suggested that these instruments remain difficult to operationalize, as Pakistan

lacks a strong pipeline of bankable green transport projects. Without such a pipeline, the tools of the capital markets may be symbolic rather than transformative.

"The green financial ecosystem in Pakistan is still poor, and the access to the global funds is also a difficult procedure as it faces procedural inefficiencies," YD noted. HJ added, "A lot of local institutions are not aware of the financial instruments that are available, and thus they miss out [on] opportunities of funding." Regarding green bonds, HJ stated, "The government needs to enable the issuance of green bonds and earn people's trust to invest." BI further emphasized, "Overregulation leads to implementation of layers of bureaucracy that finalizes efforts of stakeholders in actually seeing progress."

On PPPs, YD explained, "PPPs offer a viable pathway to attract private sector investments, reducing the financial burden on the government." SL added, "Collaborating with private entities can unlock access to global capital and innovative financing solutions." However, uptake remains slow. Regarding global funds, DB remarked, "The GCF and similar mechanisms offer an avenue for developing countries like Pakistan to access concessional finance but the process takes too long and procedural delays are common," echoing findings by the Climate Policy Initiative.¹⁷

The financing challenges identified in this study can be broadly classified into domestic and international constraints, each requiring different policy responses. Domestically, the financial sector in Pakistan suffers from limited expertise in structuring green financial instruments, weak green investment structures, and regulatory uncertainties that deter private-sector participation in sustainable transport projects. Internationally, access to global climate finance mechanisms, such as concessional funds or climate investment facilities, remains difficult due to complicated approval processes and low institutional capacity to prepare bankable green transport projects. In addition, various segments of the transportation sector require specialized financing methods. Large-scale infrastructure, such as BRT systems, metro rail, and electrified public transport networks, requires substantial long-term capital investments, which can be funded through green bonds and green sukuk. EVs and their charging infrastructure can benefit from blended finance models that combine government incentives, private-sector investment, and concessional international funding. Aligning specific green finance instruments with these sector-specific investment needs is therefore crucial to accelerating the transition toward sustainable mobility in Pakistan.

4.4. Theme 4: Global lessons and best practices

The fourth theme shows that participants valued international examples of sustainable transport financing. However, they did not view them as directly transferable to Pakistan. Cases such as Norway, the Netherlands, Shenzhen, and India were generally seen as useful references. Nevertheless, respondents emphasized that these examples emerged under different institutional, fiscal, and regulatory conditions. Accordingly, participants favored policy adaptation rather than policy imitation.

Stakeholders cited Shenzhen's success with electric public transit. HJ said, "Developing charging stations across urban and rural areas is vital for EV success in Pakistan," while DB noted, "There is a need for a robust regulatory framework to standardize EV technology." This mirrors Shenzhen's experience, where local governments provided structured regulatory and financial support. According to MI, "We need innovative financing models, low-interest loans, to be able to really make this broader," suggesting lessons from China's green bond-backed transit reforms.

Regarding Norway and Singapore, participants cited the value of tax and subsidy frameworks. SL noted, "Fuel cost savings were amongst the key drivers to encourage the consumers to opt for EVs," and MI emphasized, "Public awareness campaigns should be coupled with government-backed subsidies to help adoption rates increase." YD added, "India's success in using green bonds for urban mobility is a template Pakistan must explore," hinting at the value of global policy learning. This matches the International Energy Agency's finding that fiscal and infrastructure investments significantly increased EV adoption across developed countries.¹⁸

While international experiences provide valuable insights, their applicability to Pakistan requires careful adaptation to the country's socio-economic and institutional context. Unlike countries such as Norway and the Netherlands, Pakistan faces fiscal constraints, limited EV infrastructure, and weaker institutional coordination across federal and provincial levels. Therefore, rather than replicating these models directly, Pakistan can adopt selective policy elements, such as targeted fiscal incentives for EV adoption, gradual expansion of charging infrastructure in major urban centers, and the use of green bonds or blended finance mechanisms to support large-scale public transport electrification. Lessons from countries such as India are particularly relevant, as similar institutional and economic conditions demonstrate how developing economies can leverage green finance tools and policy incentives to scale sustainable mobility initiatives.

These contextual adaptations highlight the importance of aligning global best practices with Pakistan's regulatory capacity, financial constraints, and urban mobility priorities.

The finding is consistent with the international literature, which shows that sustainable transport implementation is shaped by local political, institutional, and social realities. As previously stated⁵, even highly developed contexts face contradictions between sustainability goals and actual investment choices. Similarly, alternative mobility systems are shaped by social acceptance and policy controversy. For Pakistan, this means that global lessons are useful only when filtered through domestic realities, such as fragmented governance, limited market depth, and constrained administrative capacity.

5. Discussion

The findings of the current research suggest that green finance for sustainable transport in Pakistan is limited not only by a lack of institutional funds but also by a combination of institutional fragility, policy fragmentation, market constraints, and sector-specific transport needs. Interviews indicate that Pakistan has begun developing a policy and regulatory vocabulary for green finance. However, this nascent development has not yet grown into a transport-focused financing ecosystem that can underpin large-scale mobility transitions. This discussion grounds the findings in six interrelated lenses: domestic and international barriers; sector-specific financing needs; the transferability of global best practices; the causal relationship between institutional barriers and policy misalignment; governance implications of federal-provincial fragmentation; and the case for a phased financing blueprint.

5.1. Domestic and international roadblocks to funding sustainable transport

A major contribution of this study is the distinction between domestic and international barriers to sustainable transport finance in Pakistan. The findings suggest that barriers within countries provide a basic foundation for whether international financing opportunities can be successfully assimilated. These domestic obstacles include poor bureaucratic and technical capacity, shallow capital markets, patchy policy responsibilities, inconsistent inter-agency coordination, and a lack of project preparation expertise. Such impediments degrade the capacity of public institutions to develop bankable transport projects, match financing mechanisms to sectoral needs, and provide the policy certainty necessary for investors.

In contrast, international barriers are outside, yet very consequential. They include reliance on cycles of donor-

backed financing, stringent compliance requirements attached to climate funds, external perceptions of the risk of governance and implementation, and difficulty attracting international green capital in a context where transport finance remains administratively fragmented. However, the analyses suggest that these external barriers do not function in isolation; rather, they are more severe when domestic systems are weak. In other words, even when international capital is available, Pakistan may not be able to reap its benefits because its domestic agencies cannot prepare credible proposals, meet reporting and fiduciary obligations, or coordinate among federal-, provincial-, and city-level institutions.

This interpretation is important because it shifts the discourse from a simplistic “lack of funds” narrative to a more complex understanding of financing capacity. The findings suggest that green finance in Pakistan is constrained by limited access to appropriate capital and by limited institutional capacity to structure, govern, and sustain its utilization. This view is consistent with the more general sustainable transport implementation literature, which highlights that policy outcomes are not just a matter of objectives and the availability of funds, but also of the institutional systems that turn funding into projects.⁵

5.2. Sector-specific financing requirements and customized green finance products

Interviews further indicate that financing requirements in the transport sector in Pakistan are heterogeneous and require that green finance tools be adapted to different transport subsectors. This resolves an important shortcoming: treating green finance mechanisms too generally.

For large-scale public transport infrastructure, including the expansion of BRT, upgrading of metro rails, modernization of intercity rails, and electrification of public bus systems, the financing requirements are long-term, capital-intensive, and institutionally complex. These types of projects typically require sovereign credibility, long-term finance, public guarantees, and reliable intergovernmental coordination. In such contexts, green bonds and green sukuk would seem more appropriate, as they can mobilize larger pools of capital and serve as structured financing instruments for environmentally beneficial projects. In Pakistan, green sukuk may be especially relevant given the compatibility of the country with the structures of Islamic finance.

For EV charging infrastructure, fleet conversion pilots, and smart mobility systems, the financing profile looks different. Such projects tend to be medium-scale or incremental investments, characterized by higher

uncertainty, longer payback horizons, and greater first-mover risk. For these initiatives, blended finance is more appropriate, as it allows concessional or public capital to cover the risk and attract private investors. Likewise, PPPs may be viable for charging networks, fleet leasing arrangements, mobility platforms, and depot infrastructure, but only where contractual terms are credible and revenue streams sufficiently predictable.

For municipal- or city-scale mobility improvement projects, such as intelligent traffic systems, bus priority corridors, active mobility infrastructure, and integrated last-mile connectivity, the findings showed a need to more closely link financing to urban planning and city governance. In these areas, Pakistan currently lacks a mature municipal financing model, hindering the replicability of city-led sustainability financing approaches observed internationally. This suggests that transport finance in Pakistan must be designed not only based on the type of project but also on the institutional maturity and level of implementation.

Consequently, the argument reaches a context-specific conclusion: the key challenge is not the availability of green finance instruments, but rather identifying the right fit between existing instruments and the specific financing logic of each transport subsector. This is the area where the present system of Pakistan is underdeveloped.

5.3. Analytical importance of global best practices for Pakistan

The empirical evidence also suggests that international case studies, such as those of Norway, the Netherlands, Shenzhen, and India, have analytical value when subjected to a rigorous contextual examination rather than mere superficial description. The initial studies were too dependent on descriptive accounts of these examples. In contrast, the present analysis systematically evaluates the conditions under which success was achieved in those models and assesses the extent to which similar conditions are available in Pakistan.

For example, Norway's EV transition was based on strong fiscal capacity, continued policy continuity, coordinated tax benefits, and high household purchasing power. The experience of the Dutch was fostered by well-established urban planning institutions, integrated cycling and transit ecosystems, and a stable tradition of public investment. Shenzhen's electrification of the bus fleet was made possible by an effective municipal governance structure, large-scale, state-supported industrial coordination, and significant implementation capacity. India's strategy is relevant to Pakistan in terms of common institutional characteristics and developmental trajectories, especially regarding

phased transition policies, localized manufacturing stimuli, and targeted electrification policies. Nevertheless, even in India, policy success has relied on a larger market scale, greater diversification of subnational implementation, and a broader experimentation base than currently exists in Pakistan.

The important thing to note is that these models worked not so much because of the particular financing instruments used, but rather because of the broader institutional and economic ecosystems in which those instruments operated. Pakistan lacks some of these enabling conditions, such as deep capital markets, high municipal fiscal autonomy, robust local borrowing mechanisms, and consistent intergovernmental coordination. Consequently, the direct transfer of these models is not possible.

Nevertheless, the findings indicate that certain elements can be transferred through adaptation, including:

- phased transport transition strategies rather than sudden system-wide transformations;
- targeted and sequenced incentives, as opposed to undifferentiated and broad subsidies;
- blended-risk strategies for early-stage and risky projects;
- improved linkages between transport policy and climate and urban development planning; and
- pilot-based experimentation preceding large-scale replication.

This reinterpretation reinforces the policy-learning aspect of the study. Rather than the international examples serving as templates for emulation, the study now considers them as sources of flexible principles subject to the institutional and fiscal realities of Pakistan. This view is supported by the literature, which shows that sustainable transport policies are shaped by implementation politics, institutional path dependence, and public controversy despite being in a relatively advanced setting.^{5,10}

5.4. Causal interaction between institutional weakness and policy mismatch

A strong reviewer criticism was that there was no explanation of how institutional weakness and policy alignment reinforce each other. Given the qualitative case study methodology of this research, statistical modeling was inappropriate; however, there is thematic evidence to allow a coherent articulation of the causal and dynamic relationship between these two factors.

The findings show that institutional weakness contributes to policy misalignment in at least four ways. First, low bureaucratic and technical capacity limits

agencies' ability to develop integrated green finance and transport policies. Second, poor inter-agency coordination leads to policies being developed in isolation, so that the transport, finance, climate, and industrial domains go along parallel lines, rather than as part of a coherent package. Third, inadequate accountability mechanisms undermine follow-through, thereby making implementation pathways ambiguous, even when policies are formally announced. Fourth, poor project preparation systems result in policy aspirations failing to be translated into bankable investment proposals.

Concurrently, misalignment of policy furthers the institutional capacity. Ambiguous mandates, overlapping responsibilities, and fragmented implementation frameworks hinder the ability of institutions to build expertise, establish coordination routines, and accumulate operational learning. This creates a self-reinforcing cycle: weak institutions lead to fragmented policies; fragmented policies lead to uncertain implementation environments; uncertain environments lead to a lack of financing and project uptake; reduced uptake leads to a lack of experiential gains that could drive institutional improvement. Accordingly, institutional weakness and policy misalignment are inter-policy, not parallel, challenges.

This explanation provides the scientific rationale that was lacking in the previous draft and helps us understand why the green transport financing challenge in Pakistan cannot be solved by introducing new instruments such as green bonds and PPPs. Unless the institutional-policy interface is strengthened, even well-designed financing tools may remain underutilized.

5.5. Federal-provincial fragmentation and manifestation of governance in practice

The study goes on to explain, operationally, how federal-provincial fragmentation manifests. Green finance and transportation governance in Pakistan involve various actors, whose mandates intersect but are not fully synchronized. At the federal level, some of the most prominent players include the Ministry of Climate Change and Environmental Coordination, the Ministry of Finance, SBP, SECP, the Ministry of Industries and Production, and the Planning Commission (Ministry of Planning, Development, and Special Initiatives). At the provincial level, transport departments and related implementing bodies are responsible for operational transport planning, regulation, and (in some cases) execution of urban transit. At the city/metropolitan level, the transport authorities and implementing agencies may be responsible for providing bus services, transit corridors, and rationalizing routes and

mobility operations.

The problem is not so much the multiple actors as the mismatch between their objectives and time horizons. Financial regulators may be more interested in prudential stability and market development; climate agencies may be more interested in mitigation and environmental commitments; industrial bodies may be interested in vehicle manufacturing and industrial incentives; provincial transport departments may be interested in operational mobility needs; and city-level implementers may be faced with immediate service-delivery constraints. In the absence of an effective coordination mechanism, these disparate priorities may result in partial, inconsistent, or delayed implementation.

In practice, this fragmentation is manifested by:

- electrification aspirations accompanied by no equivalent financing pathways;
- green reforms in the financial sector decoupled from transport sector project pipelines;
- climate targets with no clear implementation ownership; and
- provincial execution responsibilities are out of line with appropriate federal financing.

For example, there are city-level mobility needs that are decoupled from national green finance frameworks.

Such fragmentation is a governing and financing problem. Investors and development partners are more likely to become engaged if governance responsibilities are transparent, if project ownership is stable, and if implementation chains are credible. Consequently, federal–provincial fragmentation has a direct negative impact on the bankability of sustainable transport projects.

5.6. Three-tier financing blueprint for Pakistan

The analysis is an endorsement of a three-tier financing blueprint, not as a panacea, but as a sequencing strategy based on Pakistan's institutional and sectoral realities.

5.6.1. Tier 1: Public and regulatory base

The first tier focuses on policy alignment, institutional capacity building, and project preparation. It is based on the observation that market-based finance does not scale in settings characterized by fragmented governance and weak project pipelines. Accordingly, this tier consists of integrating green finance clauses into transport and EV policies, specifying federal–provincial responsibilities, strengthening project appraisal capacities, and creating transport-specific investment frameworks. Empirical evidence suggests that the reasons for financing difficulties in Pakistan lie in institutional preparedness rather than in

capital availability alone.

5.6.2. Tier 2: Blended and concessional de-risking

The second tier uses concessional support, donor-linked facilities, and blended finance to reduce risk in early-stage or uncertain transport segments. The rationale for this approach is that many transport investments in Pakistan, especially those in EV charging infrastructure, municipal fleet pilots, and smart mobility systems, are exposed to commercial uncertainty that private investors are unlikely to absorb on their own. By partially absorbing the initial risk, blended mechanisms can generate proof of concept, attract private co-techfinancing, and facilitate institutional learning during implementation.

5.6.3. Tier 3: Market-based scale-up

The third stage is the large-scale issuance of green bonds, green sukuk, and mature PPP structures for projects with stronger revenue potential, robust regulatory support, and greater institutional credibility. The rationale is that these instruments are only maximally effective once the state has built stronger coordination, more credible project pipelines, and sufficient market trust. In the prevailing Pakistani context, reliance on a pure market-led green approach to transport finance would be premature; a phased model is both scientifically and practically justified. As a result, the blueprint goes beyond being a policy preference. It is grounded in evidence that suggests the financing challenge for Pakistan is sequential: strengthening governance must come before de-risking, which in turn must precede the mobilization of large volumes of capital in capital markets.

5.7. Implications for the liveability and health of cities and smart mobility

Ultimately, the findings show that green finance for sustainable transportation should be conceptualized as a wider urban development issue. Sustainable transport investments not only reduce emissions but also improve air quality, health, transport efficiency, accessibility, and the overall liveability of cities. Malik *et al.*¹⁰ showed a strong link between transport-related pollutant emissions and urban health outcomes, while Raihan and Sarker⁶ emphasized the need for integrated consideration of environmental and infrastructural systems to support healthy and sustainable urban development. Similarly, other researchers emphasized the importance of upcoming mobility transitions that increasingly rely on smart systems, digital coordination, user trust, and the general adaptability of urban environments.^{5,8} In Pakistan, financing cleaner public transport, electrified mobility, and smarter transport systems can yield multiple co-benefits, including reduced congestion, reduced exposure to pollution, enhanced

public health, smoother urban movement, and better adaptive mobility planning. Framing sustainable transport finance in this way also enhances the policy relevance of this study. Rather than being seen purely as a climate finance issue, it is incorporated into a broader agenda of urban improvement and public well-being. This broader framing is significant for Pakistan, as it could be used to justify sustainable transport investments when the case may not be strong enough to support investments based solely on climate arguments.

5.8. Limitations of the study

This study is subject to several limitations. First, the qualitative design and the limited sample size ($n = 10$) restrict the generalizability of findings beyond the specific institutional context examined. While stakeholders were selected based on expertise and sectoral relevance, the perspectives captured may not fully represent all actors involved in transport and green finance governance across Pakistan. Second, the study relies on self-reported interview data, which may be influenced by institutional bias or individual perceptions. Third, the research does not employ quantitative modeling or financial simulations to assess the economic feasibility of the proposed financing framework. Future research may incorporate mixed-method approaches, larger stakeholder samples, or econometric analysis to further validate and operationalize the proposed financing blueprint.

5.9. Recommendations

The findings suggest that global experience in green finance and sustainable transportation is relevant to Pakistan only if it is adapted to local institutional, financial, and governance realities. Instead of directly following models from Norway, the Netherlands, Shenzhen, or India, Pakistan needs to engage in selective policy learning that reflects its fragmented governance structure, the limited depth of its capital market, and its limited capacity to prepare projects.

First of all, Pakistan should establish a national coordination platform for green transport finance that brings together climate, finance, planning, regulatory, industrial, and provincial transport bodies. Such a platform would enable alignment between transport decarbonization objectives and financing mechanisms, thereby reducing institutional fragmentation.

Second, the country should be able to adopt a sector-specific financing framework. Large-scale projects, such as the expansion of BRT, the modernization of railways, and the electrification of public bus systems, are better suited for financing through green bonds and green sukuk.

In contrast, EV charging infrastructure, fleet pilots, and smart mobility systems, which involve higher risk at the early stages of implementation, are better suited to blended finance and PPPs.

Third, Pakistan needs more project preparation assistance so that transport agencies can prepare bankable green projects. Dedicated technical support on feasibility analysis, financial structuring, and compliance with green finance standards would enhance investment readiness. Fourth, a phased pilot-to-scale approach should be adopted. Rather than nationwide implementation, sustainable transport financing initiatives should be tested first in major urban centers and then expanded gradually in response to lessons learnt during implementation.

Finally, sustainable transportation finance should be framed not only as a climate issue, but also as a pathway to urban liveability, better health, smoother transportation, and smart mobility. This broader framing would make green transport investment more relevant to Pakistan's development priorities and strengthen the policy value of global lessons in the local context.

6. Conclusion

This study examined the role of green finance in advancing sustainable transportation in Pakistan through a qualitative case study approach. The findings show that Pakistan has made visible progress in building a regulatory foundation for green finance through green bond guidance, Green Sukuk initiatives, and climate-oriented financial reforms. However, this progress has not yet translated into a coherent and transport-focused financing ecosystem. The study found that institutional weakness, policy misalignment, federal-provincial fragmentation, and weak project preparation capacity jointly constrain the effective use of green finance tools in the transportation sector.

The analysis further shows that financing needs in transport are sector-specific. Large-scale public transport infrastructure requires long-term instruments such as green bonds and green sukuk, whereas EV charging systems, fleet pilots, and smart mobility projects require blended finance, concessional support, and carefully structured PPPs. International examples offer useful lessons, but they are not directly transferable to Pakistan without adaptation to local governance, market, and administrative realities. Therefore, the study concludes that Pakistan needs a phased and context-sensitive strategy that aligns institutions, policies, and financial tools. Green finance for transportation should also be understood as a broader development priority because it contributes not only to emissions reduction, but also to urban liveability, public health, smoother transportation, and smarter

mobility systems.

Acknowledgments

None.

Funding

None.

Conflict of interest

The authors declare no competing interests.

Author contributions

Conceptualization: Rana Sakandar Hayat, Sumera Iqbal

Formal analysis: Hamza Iftikhar

Investigation: Ume Laila Shah

Methodology: Hamza Iftikhar

Visualization: Atiqah Binte Fayyaz

Writing–original draft: Atiqah Binte Fayyaz

Writing–review & editing: Ume Laila Shah

Ethics approval and consent to participate

Ethical approval for this study was obtained from the S3H Ethics Committee, NUST. Participation was voluntary, and informed consent was obtained from all participants.

Consent for publication

Informed consent was obtained from all participants to publish their data.

Availability of data

Data are available from the corresponding author upon reasonable request.

References

- Güzel TD, Alp K. Modeling of greenhouse gas emissions from the transportation sector in Istanbul by 2050. *Atmos Pollut Res.* 2020;11(12):2190–2201.
doi: 10.1016/j.apr.2020.08.034
- Khan G, Saddiqa A, Szczucka-Lasota B, Węgrzyn T, Piotrowicz P, Sultana B. Climate change related transportation management in Pakistan-greenhouse gas emission review, mitigation strategies and adaptation measures. *Sci Pap Sil Univ Technol Organ Manag Ser.* 2025;(224):135–174.
doi: 10.29119/1641-3466.2025.224.8
- Securities and Exchange Commission of Pakistan. *SECP issues Guidelines for Green Bonds Issuance in Pakistan.* 2021. Available from: <https://secp.gov.pk/wp-content/uploads/2021/06/Press-Release-June-18-SECP-issues-Guidelines-for-Green-Bonds-Issuance-in-Pakistan.pdf> [Last accessed on].
- Ceder A. *Public Transit Planning and Operation: Modeling, Practice and Behavior.* 2nd ed. CRC Press; 2016.
doi: 10.1201/b18689
- Alam S, Qadir G, Rahman RU. Green entrepreneurship and sustainable development: Evidence from Pakistani SMEs. *Bull Manag Rev.* 2024;1(4):454–477.
- Raihan A, Sarker T. Financial mechanisms for advancing environmental sustainability: a comprehensive review. *Green Technol Resil Sustain.* 2026;6(1):4.
doi: 10.1007/s44173-026-00029-9
- Tonne C, Adair L, Adlakha D, et al. Defining pathways to healthy sustainable urban development. *Environ Int.* 2021;146:106236.
doi: 10.1016/j.envint.2020.106236
- Mak HWL, Ng DCY. Spatial and socio-classification of traffic pollutant emissions and associated mortality rates in high-density Hong Kong via improved data analytic approaches. *Int J Environ Res Public Health.* 2021;18(12):6532.
doi: 10.3390/ijerph18126532
- Modarelli G, Sadraei R, Rainero C. How to perceive sustainable moving and smart mobility today? A cross-national comparative longitudinal perspective and the controversy of alternative transport systems. *J Clean Prod.* 2024;468:143121.
doi: 10.1016/j.jclepro.2023.143121
- Malik AZ, Naz NS, Ahmed F, et al. Enhancing smart city mobility through real time explainable AI in autonomous vehicles. *Sci Rep.* 2025;15(1):42118.
doi: 10.1038/s41598-025-25993-3
- Pakistan Stock Exchange Limited. PSX Ministry of Finance Hosts Briefing On Sovereign Domestic Green Sukuk. 2025. Available from: <https://www.psx.com.pk/psx/events-psx/psx-ministry-of-finance-hosts-briefing-on-sovereign-domestic-green-sukuk> [Last accessed on June 18, 2024].
- State Bank of Pakistan. Environmental and Social Risk Management (ESRM) Implementation Manual. Annex 3. 2022. Available from: <https://www.sbp.org.pk/smfed/circulars/2022/CL12-Annex-3.pdf> [Last accessed on May 7, 2026].
- Chouhan N, Harrison C, Sharma D. *Global State of the Market Report 2023.* Climate Bonds Initiative. 2024. Available from: <https://www.climatebonds.net/files/documents/publications/Global-State-of-the-Market-Report-2023.pdf> [Last accessed on May 7, 2026].
- Hunjra AI, Hassan MK, Zaied YB, Managi S. Nexus between green finance, environmental degradation, and sustainable development: Evidence from developing countries. *Resour Policy.* 2023;81:103371.
doi: 10.1016/j.resourpol.2023.103371

15. Cui X, Said RM, Rahim NA, Ni M. Can green finance Lead to green investment? Evidence from heavily polluting industries. *Int Rev Financ. Anal.* 2024;95:103445.
doi: 10.1016/j.irfa.2023.103445
16. Naqvi B, Rizvi SKA, Mirza N, Umar M. Financial market development: a potentiating policy choice for the green transition in G7 economies. *Int Rev Financ. Anal.* 2023;87:102577.
doi: 10.1016/j.irfa.2023.102577
17. Ministry of Climate Change Pakistan. *National Climate Change Policy Report*. 2018. Available from: <https://mocc.gov.pk/SiteImage/Policy/NCCP%20Report.pdf> [Last accessed on May 7, 2026].
18. International Energy Agency. *World Energy Outlook 2023*. 2023. Available from: <https://www.iea.org/reports/world-energy-outlook-2023> [Last accessed on May 7, 2026].
19. Guo X, Bhatia M, Gupta B, Battisti E. Green project investments and corporate responsibilities: enablers, challenges, and strategies for mitigating risks. *Corp Soc Responsib Environ Manag.* 2026;33(1):419-441.
doi: 10.1002/csr.70177