From Data to Policy: Harnessing Pricing Mechanisms for Climate Action

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Executive Summary

This working paper examines the structural drivers of carbon emissions in Pakistan and assesses the policy relevance of carbon pricing within the country's economic, energy, and institutional context. Using a mixed-methods approach that combines long-run emissions diagnostics with policy and institutional analysis, the paper explains why emissions have risen persistently and identifies the policy gaps that constrain effective mitigation. Drawing on five decades of national data from 1970 to 2023, including Kaya decomposition and regional comparisons, the empirical analysis shows that emissions growth has been driven primarily by population expansion, rising energy demand, and continued reliance on fossil fuels. While energy intensity improved modestly over time, these gains plateaued in recent years and were insufficient to offset growing demand. Carbon intensity declined only marginally, reflecting slow shifts in the energy mix despite the adoption of renewable energy policies. A complementary PESTEL-based assessment of Pakistan's policy landscape highlights persistent institutional and governance constraints, including pricing distortions, fossil fuel subsidies, fragmented regulatory frameworks, and weak enforcement capacity. Together, these factors help explain the gap between stated policy commitments and observed emissions outcomes. The empirical analysis does not estimate the causal impact of carbon pricing on emissions. Instead, it establishes the structural drivers of emissions growth and the institutional conditions within which mitigation policies operate. Building on this diagnostic foundation, the paper evaluates carbon pricing as a policy-relevant response to these structural and institutional challenges. Market-based instruments such as carbon taxes, emissions trading systems, and crediting mechanisms are assessed as tools that can address price distortions, mobilize fiscal resources, and encourage low-carbon investment when introduced in a phased and context-sensitive manner. The analysis emphasizes that effectiveness depends on institutional readiness, transparent governance, and equitable revenue use, not on instrument choice alone. Intended for climate policymakers, economic planners, and energy-sector stakeholders, this working paper contributes to Pakistan-focused climate policy literature by integrating emissions diagnostics with political economy analysis and by outlining a sequenced approach to carbon pricing aligned with national development priorities and international climate commitments.

Key Messages

- The long-run emissions decomposition shows that Pakistan's energy-related CO_2 emissions increased by approximately 880–900% between 1970 and 2023, driven primarily by population growth and rising GDP per capita, while reductions in energy and carbon intensity remained limited (Kaya decomposition; Section 3.1, Figures 3–5).

- Time-series and comparative analyses indicate that energy demand and fossil fuel consumption have remained the dominant contributors to emissions growth, with primary energy consumption closely tracking emissions trends and the fuel mix exhibiting limited structural change despite renewable energy policies (Sections 3 and 4; Figures 7–10).

- Recent trend diagnostics show that improvements in energy efficiency have been modest and uneven, with declines in energy intensity slowing after the mid-2010s, thereby weakening prospects for sustained decoupling of emissions from economic growth under current policy trajectories (Section 4; Figures 6 and 10).

- Policy and institutional analysis reveals that existing energy and climate policies remain fragmented and weakened by pricing distortions, subsidies, and enforcement gaps, helping to explain the persistence of carbon-intensive outcomes despite stated mitigation commitments (Sections 5 and 6; Tables 3 and 4).

- Based on the identified structural and institutional gaps, the analysis evaluates carbon pricing as a policy-relevant response to weak price signals, fiscal constraints, and underinvestment in low-carbon technologies, not as an empirically demonstrated mitigation outcome (Sections 6 and 7).

- The institutional feasibility assessment indicates that a phased approach beginning with a carbon tax leveraging existing fuel taxation systems, complemented by crediting mechanisms and followed by a potential emissions trading system best aligns with Pakistan's current administrative capacity, while allowing gradual strengthening of MRV, legal, and governance frameworks (Section 7.4; Figures 12–14).

- Social and political economy analysis shows that the effectiveness and durability of carbon pricing depend on transparent revenue recycling, social protection, and energy security investments, not on price levels alone (Section 7.5).

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Section 1: Background

Pakistan, with a population exceeding 240 million, ranks among the most climate-vulnerable countries globally (Arshed et al., 2024). Despite contributing less than 1% of global greenhouse-gas (GHG) emissions, it faces disproportionately severe climate impacts, including extreme heatwaves, accelerated glacial melt, catastrophic flooding, and prolonged droughts. The unprecedented losses caused by the 2022 and 2025 floods and heat extremes underscored the scale of climate risk confronting the country and drew renewed national and international attention to the urgency of climate action (Abubakar et al., 2024). According to the World Bank's *Pakistan Country Climate and Development Report* (2022), adequately responding to Pakistan's climate and development challenges between 2023 and 2030 will require investments of approximately US$ 348 billion, equivalent to 10.7% of cumulative GDP over the same period.

Figure 1: *The 2022 floods in Pakistan forced thousands to flee on foot, highlighting the acute vulnerability of the country to climate-induced disasters.*

Climate-related shocks have intensified over the past decade, disrupting livelihoods, damaging infrastructure, and placing mounting pressure on food, water, and energy security. In 2023, Pakistan's total carbon emissions were estimated at approximately 200.7 million tons of CO_2, accounting for around 0.5% of global emissions. Although per-capita emissions remain low at about 0.8 tons, well below the global average of 4.7 tons, national emissions have risen steadily, driven primarily by energy-intensive growth in the industrial and transport sectors. According to Pakistan's Third National Communication to the UNFCCC, the energy sector accounted for approximately 41% of total national GHG emissions in 2021, making it the single largest source of emissions, with fossil fuels dominating the energy mix and driving the carbon footprint of the country.

Rapid urbanization and population growth are compounding these pressures. As of 2023, 38% of Pakistan's population resided in urban areas, a figure projected to exceed 50% by 2040 (Chohan, 2024). This demographic shift is accelerating demand for electricity, housing, transport, and basic services, placing further strain on an already fragile energy system. Concurrently, Pakistan's heavy reliance on imported fossil fuels undermines energy security and macroeconomic stability. In FY 2023, the national energy import bill exceeded USD 12 billion, significantly contributing to the trade deficit and exposing the economy to international fuel-price volatility.

Environmental degradation also imposes substantial health and economic costs. Air pollution alone is estimated to cost Pakistan approximately 6.5% of GDP annually, making it one of the most polluted countries in terms of ambient air quality. Air pollution is the 6th leading risk factor for mortality, reducing average life expectancy by an estimated 4.3 years relative to World Health Organization guidelines (World Bank, 2019). More broadly, emissions of carbon, $PM_{2.5}$, and NO_x generate cascading costs, including increased healthcare expenditures and productivity losses, fiscal burdens associated with environmental remediation and subsidies, income and livelihood losses for households and businesses, and long-term environmental damage such as ecosystem degradation and water contamination.

In response, Pakistan has adopted a range of climate and energy policies and pledged under the Paris Agreement to reduce projected GHG emissions by 20% by 2030 relative to business-as-usual levels, conditional on international support (Government of Pakistan, 2021). However, achieving this target requires more than sector-specific programs. While regulatory standards, renewable-energy incentives, and energy-efficiency initiatives have contributed to incremental progress, mitigation outcomes remain limited. Regulatory approaches have often suffered from weak enforcement, fragmented institutional mandates, and uneven provincial capacity. Subsidy-based interventions, particularly in the power and fuel sectors have frequently distorted price signals, encouraged inefficient energy use, and imposed significant fiscal costs, while delivering modest and uneven emissions reductions. Persistent fossil fuel subsidies, in particular, have undermined incentives for low-carbon investment and entrenched carbon-intensive development pathways. International experience from comparable emerging economies suggests that regulatory and subsidy-based approaches alone rarely achieve sustained emissions reductions without an accompanying economy-wide price signal.

The absence of an integrated, economy-wide carbon policy framework represents a critical structural gap. Carbon pricing emerges in this context not as a normative policy preference, but as a corrective response to the limitations of existing regulatory and subsidy-based approaches. By internalizing the external costs of carbon across the economy, pricing mechanisms address a core weakness of current policies: the lack of a consistent and transparent signal that aligns private decision-making with climate and development objectives. Carbon pricing can complement regulatory standards and targeted subsidies by improving allocative efficiency, reducing reliance on discretionary enforcement, and generating predictable fiscal revenues that can be recycled toward clean-energy investment, climate adaptation, and social protection. Framed in these terms, carbon pricing offers a pragmatic instrument for overcoming institutional fragmentation and fiscal constraints while strengthening the coherence and effectiveness of Pakistan's broader climate policy framework.

This working paper examines the structural drivers of Pakistan's emissions trajectory and evaluates the feasibility of carbon-pricing options within the country's political, economic, social, technological, environmental, and legal context. By integrating empirical analysis with policy assessment, it provides evidence-based insights to support the design of carbon-pricing instruments aligned with national development priorities and international climate commitments. The paper aims to inform policymakers, economic planners, and energy-sector stakeholders by outlining actionable pathways toward a just, inclusive, and resilient low-carbon transition for Pakistan.

Section 2: Methodology

This working paper employs a mixed-methods analytical framework that combines quantitative emissions decomposition with qualitative policy analysis to examine Pakistan's emissions trajectory and assess the feasibility of carbon-pricing instruments. The methodological design links observed emissions patterns with underlying economic, energy-system, demographic, fiscal, and technological factors, while situating these dynamics within the country's institutional and policy context. The analysis proceeds through five interrelated components: empirical trend analysis, Kaya decomposition, policy landscape mapping, strategic feasibility assessment, and synthesis for policy design.

2.1 Empirical Trend Analysis

A long-run time-series dataset spanning 1970–2023 was constructed using internationally recognized data sources, including the World Bank (World Development Indicators), OECD Statistics, and Our World in Data. The empirical analysis draws on a set of variables selected to capture both the structural drivers of emissions growth and the policy-relevant dimensions of Pakistan's energy–economy nexus.

Economic activity is represented by GDP in purchasing power parity (PPP) terms and GDP per capita, reflecting both the scale and intensity of economic growth. Emissions outcomes are measured using CO_2 emissions and total GHG emissions, along with the carbon intensity of GDP, which captures the emissions efficiency of economic output. Energy-system characteristics are described using indicators of primary energy consumption, energy intensity, fossil fuel dependence, and renewable energy share. These indicators allow assessment of demand-side pressures as well as fuel-mix composition. Demographic change is proxied by urban population share, reflecting the role of urbanization in shaping energy demand, transport use, and industrial activity.

To link emissions dynamics with policy capacity and long-term mitigation potential, the analysis also incorporates fiscal and innovation-related variables. Environmentally related tax revenue serves as an indicator of the extent to which environmental externalities are reflected in fiscal instruments. Research and development expenditure and environment-related patents are used as proxies for technological capability and innovation readiness. Each group of variables captures a distinct dimension of emissions dynamics. Economic and demographic variables reflect scale effects, energy-system indicators capture efficiency and fuel-mix composition, and fiscal and innovation variables signal capacity for policy intervention and technological transition. This consolidated framework ensures consistency between the empirical analysis and the subsequent policy assessment.

Table 1: Variables, time span, and data sources used in the study

Variable	Time Span	Source
GDP (US dollars, PPP converted, Millions, 2015)	**2000–2023**	**OECD**
CO_2 Emissions (million tons)		**Our World in Data**
Carbon intensity of GDP (kg CO_2e per 2021 PPP $ of GDP)		**WDI**
GHG Emissions		**Our World in Data**

(million tons)		
Urban population (% of total population)		**WDI**
Renewable energy consumption (% of total)	**2000–2021**	**WDI**
Energy intensity level of primary energy (MJ/2017 PPP US dollars GDP)		**WDI**
Energy use (Mtoe)	**2000–2022**	**OECD**
Fossil fuel consumption (% of total)		**WDI**
Environmentally related tax revenue (USD million)	**2011–2022**	**OECD**
Research and development expenditure (% of GDP)	**2005–2023**	**WDI**
Development of environment-related technologies (Percentage of domestic inventions)	**2004–2021**	**OECD**

2.2 Kaya decomposition of CO_2 emissions in Pakistan

To examine the structural drivers of emissions growth, the study applies the Kaya Identity to decompose Pakistan's energy-related CO_2 emissions from 1970 to 2023. The Kaya Identity expresses total emissions as the multiplicative product of population, income per capita, energy intensity, and carbon intensity:

$$\text{CO}_2\ \text{Emissions} = \text{Population} \times \frac{\text{GDP}}{\text{Population}} \times \frac{\text{Energy}}{\text{GDP}} \times \frac{\text{CO}_2}{\text{Energy}}$$

This formulation allows changes in emissions to be attributed to demographic growth, economic expansion, energy efficiency, and fuel composition (Kaya, 1990). As an accounting-based decomposition framework, the Kaya Identity is used to describe the relative contribution of these components to observed emissions growth. It does not estimate causal relationships between variables, but provides a transparent and internally consistent representation of how changes in underlying factors coincide with changes in emissions.

Cumulative Kaya Decomposition (1970–2023)

Long-term structural change is assessed by calculating percentage changes in each Kaya component between 1970 and 2023. The cumulative contribution of each factor to total emissions growth is visualized using a waterfall chart, enabling comparison of the relative influence of demographic, economic, and energy-system drivers over five decades.

$$\% \text{ Change} = \left(\frac{\text{Value}_{2023} - \text{Value}_{1970}}{\text{Value}_{1970}}\right) \times 100$$

Annual Kaya Decomposition (1971–2023)

To capture short-term dynamics, the Kaya Identity is expressed in logarithmic form, enabling additive decomposition of year-on-year changes:

$$\Delta \ln (CO_2) = \Delta \ln (\text{Population}) + \Delta \ln \left(\frac{\text{GDP}}{\text{Population}}\right) + \Delta \ln \left(\frac{\text{Energy}}{\text{GDP}}\right) + \Delta \ln \left(\frac{CO_2}{\text{Energy}}\right)$$

Annual contributions are computed using logarithmic differences between consecutive years and scaled to approximate percentage changes. Results are presented as stacked bar charts to illustrate the temporal evolution of emissions drivers.

2.3 Policy Contextualization and Landscape Mapping

Quantitative findings are interpreted within Pakistan's climate and energy policy landscape. Key instruments and commitments reviewed include the Alternative and Renewable Energy Policy (2019), Nationally Determined Contributions under the Paris Agreement, the National Climate Change Policy, fossil fuel subsidy regimes, environmentally related taxes, and regulatory standards under the National Environmental Quality Standards. This mapping evaluates the alignment between observed emissions drivers and existing policy instruments, as well as institutional coverage and implementation gaps.

2.4 Strategic Assessment Frameworks

To assess the feasibility of carbon-pricing reform, the study applies two complementary strategic frameworks. A PESTEL analysis is used to examine political, economic, social, technological, environmental, and legal factors shaping policy adoption. Kingdon's Multiple Streams Framework is employed to assess whether conditions exist for policy change through the convergence of problem recognition, policy availability, and political support. These frameworks provide a structured assessment of institutional readiness and policy constraints.

2.5 Synthesis and Policy Design

Insights from the emissions decomposition and strategic assessment are synthesized to inform the design of context-appropriate policy options. The analysis aligns observed emissions drivers with feasible mitigation instruments, with particular attention to economic viability, social equity, and institutional capacity within Pakistan's governance framework.

Section 3: Development Trajectory, Energy System, and Emissions Dynamics of Pakistan

Since the early 1990s, Pakistan has undergone profound demographic, economic, and energy-system transformations. The population nearly doubled from 116 million in 1990 to over 247 million in 2023, while GDP per capita increased by more than 70%, driven by services-sector expansion, infrastructure development, and accelerated urbanization (World Development Indicators, 2025). Figure 2 illustrates long-run GDP per capita trends for Pakistan relative to selected South Asian economies, situating the country's emissions trajectory within a broader regional development context. These demographic and economic shifts are also reflected in urbanization patterns, with the urban population share rising from 30.6% in 1990 to 38% in 2023.

Despite persistent structural challenges, these transitions coincided with improvements in selected social indicators, including life expectancy, which increased from 59.7 years in 1990 to 67.7 years in 2023. However, poverty and vulnerability remain widespread, underscoring the constraints within which energy and climate policies must operate. Pakistan's Human Development Index improved modestly from 0.394 in 1990 to 0.540 in 2022, leaving the country in the low human development category (UNDP, 2024). This development trajectory has been energy-intensive, placing sustained pressure on the energy system and embedding emissions growth within broader economic expansion.

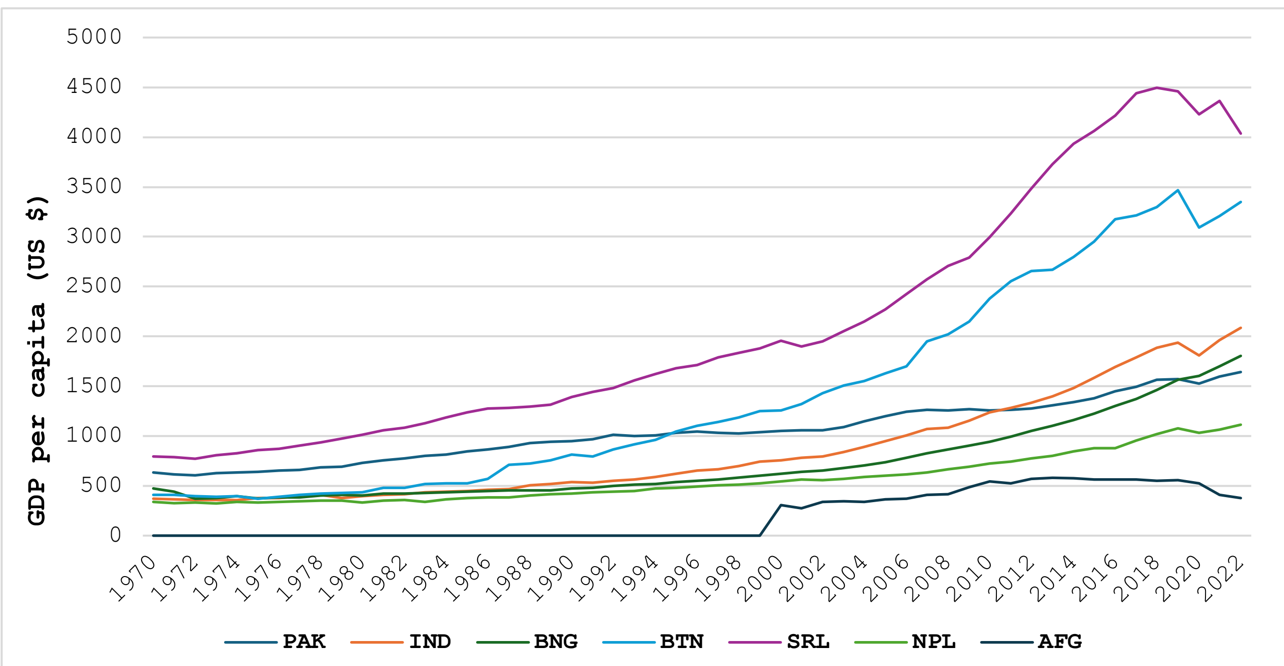

Figure 2: *Trends in GDP per capita (1970–2022) for Pakistan and regional countries (Data source: WDI, 2025).*

Historically, Pakistan's energy system relied heavily on hydropower and traditional biomass. Since the 1990s, fossil fuels particularly oil, gas, and, more recently coal, have come to dominate the energy mix. This shift was shaped by rising demand and policy choices that prioritized short-term supply expansion and price stabilization over long-term efficiency and decarbonization. The energy sector remains heavily influenced by state-owned entities such as WAPDA and NTDC, alongside Independent Power Producers operating under long-term contracts that often insulate generators from market signals. Consequently, investment incentives have favored capacity additions based on fossil fuels, while renewable deployment has remained uneven despite stated policy commitments.

Table 2: *Key socio-economic indicators for Pakistan (1990 versus 2023) (Data sources: WDI, 2025)*

Indicators	1990	2023
Population, total (million)	116.16	247.50
GDP per capita (constant 2015 US$)	950.88	1616.39
Urban population (% of total population)	30.57	38.04
Urban population growth (annual %)	4.16	2.36
Life expectancy at birth, total (years)	59.72	67.65

By 2023, electricity access exceeded 95.6% of the population (WDI, 2025), yet supply reliability remains constrained by high generation costs, transmission losses, and financial stress within the power sector. Electricity tariffs have historically been regulated below cost-recovery levels, with political considerations playing a central role in price-setting. In FY2022 alone, energy subsidies exceeded PKR 1.3 trillion, close to 2% of GDP, imposing a substantial fiscal burden. These subsidies, particularly for fossil fuel-based generation and end-user tariffs, have distorted price signals across the economy, encouraged inefficient energy consumption, and weakened incentives for investment in energy efficiency and low-carbon technologies.

Recent IMF-supported reforms have begun to address these distortions through tariff adjustments and subsidy rationalization, but structural misalignment between prices, costs, and emissions externalities persists. These pricing distortions operate through well-defined political-economy mechanisms. Below-cost electricity tariffs and fuel subsidies reduce the effective price of carbon-intensive energy, dampening incentives for efficiency improvements and low-carbon investment on the demand side. On the supply side, long-term power-purchase agreements and guaranteed returns for fossil fuel-based generation shield investors from carbon and price risk, reinforcing capital allocation toward high-emissions technologies. Together, these tariff structures, subsidies, and investment incentives lock in carbon-intensive pathways and limit the responsiveness of the energy system to stated climate policy objectives.

3.1 Kaya Indicators and Emissions Drivers (1970–2023)

The Kaya decomposition provides a structured lens through which to examine how Pakistan's development and energy policies have translated into emissions outcomes. Between 1970 and 2023, energy-related CO_2 emissions increased by approximately 879%. This growth is decomposed into four components:

- Population growth: +311.4%
- GDP per capita growth: +155.7%
- Energy intensity reduction: –13.6%
- Carbon intensity reduction: –7%

These cumulative contributions are illustrated in Figure 3. Population growth and rising income levels exerted strong upward pressure on emissions, while improvements in energy efficiency and modest reductions in carbon intensity provided only limited countervailing effects. The relatively small contribution of energy and carbon intensity reductions reflects policy and pricing structures that weakened incentives for deeper efficiency gains and fuel switching.

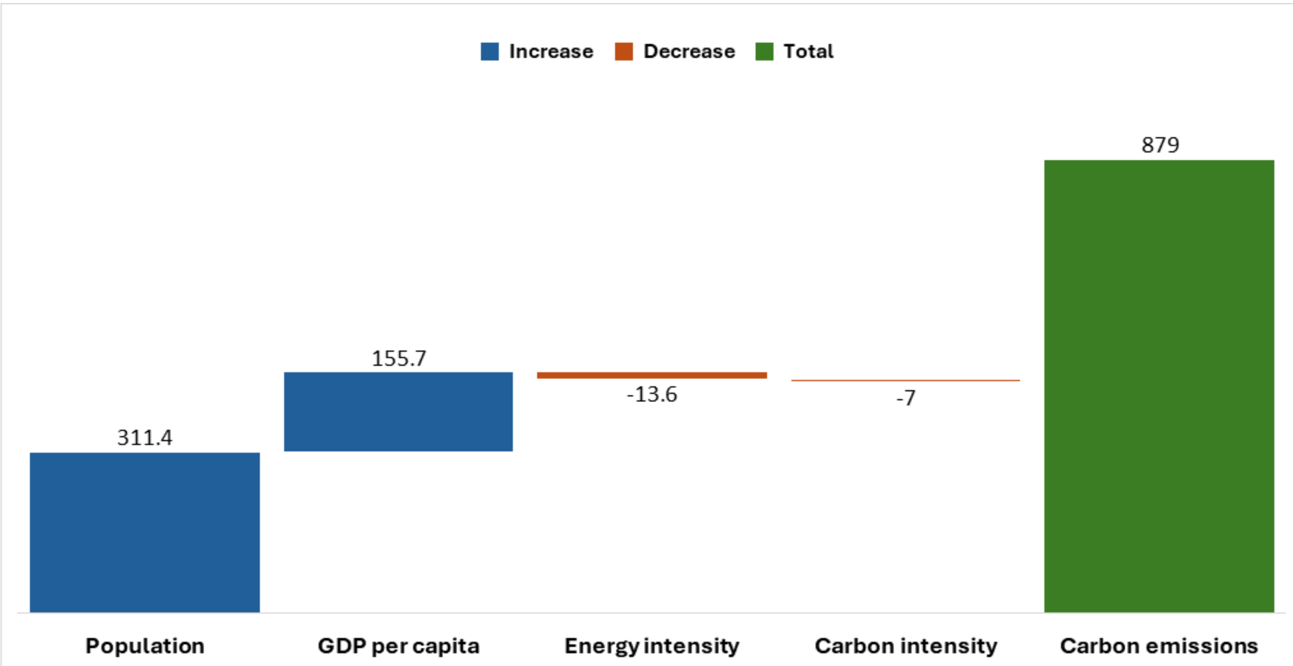

Figure 3: *Decomposition of Pakistan's CO_2 emissions using Kaya identity indicators (1970–2023).*

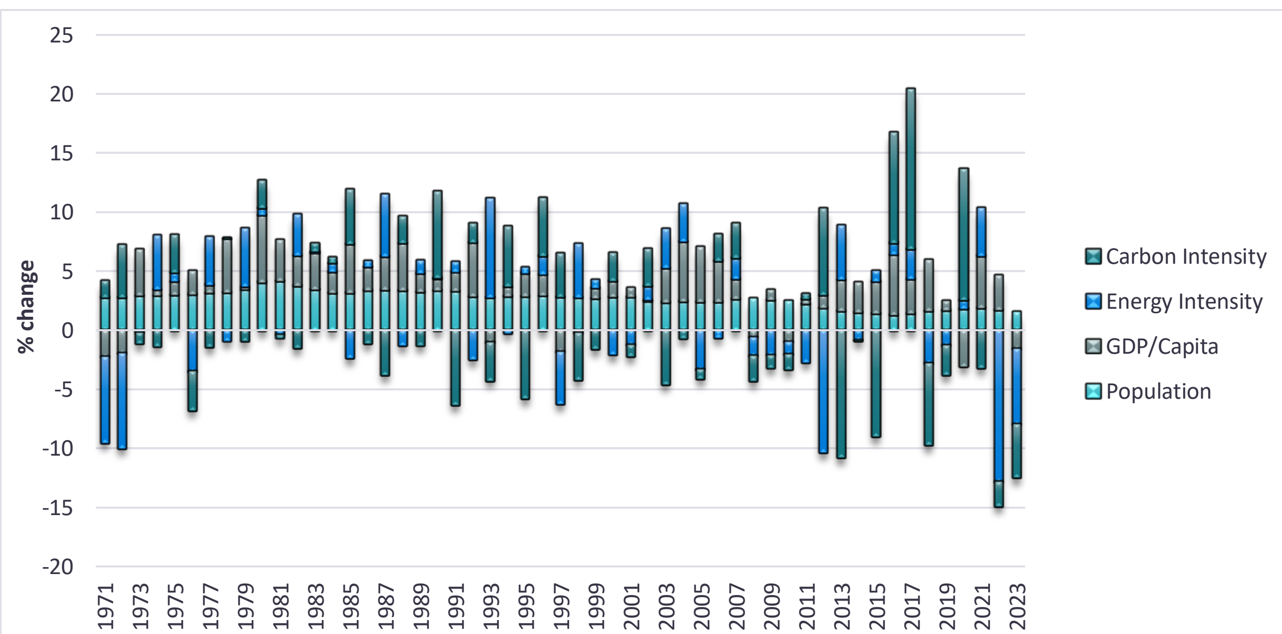

Figure 4: *Year-on-year analysis of Kaya indicators for Pakistan (1970-2023).*

The year-on-year decomposition (Figure 4), together with annual emissions changes (Figure 5), reveals substantial volatility in emissions growth, closely aligned with macroeconomic cycles, energy-demand shocks, and fuel-mix shifts. Periods of declining energy intensity coincide with episodic efficiency gains and demand compression, not sustained structural transformation. Fluctuations in carbon intensity similarly reflect shifts in fuel availability and generation dispatch, not systematic decarbonization of the energy system.

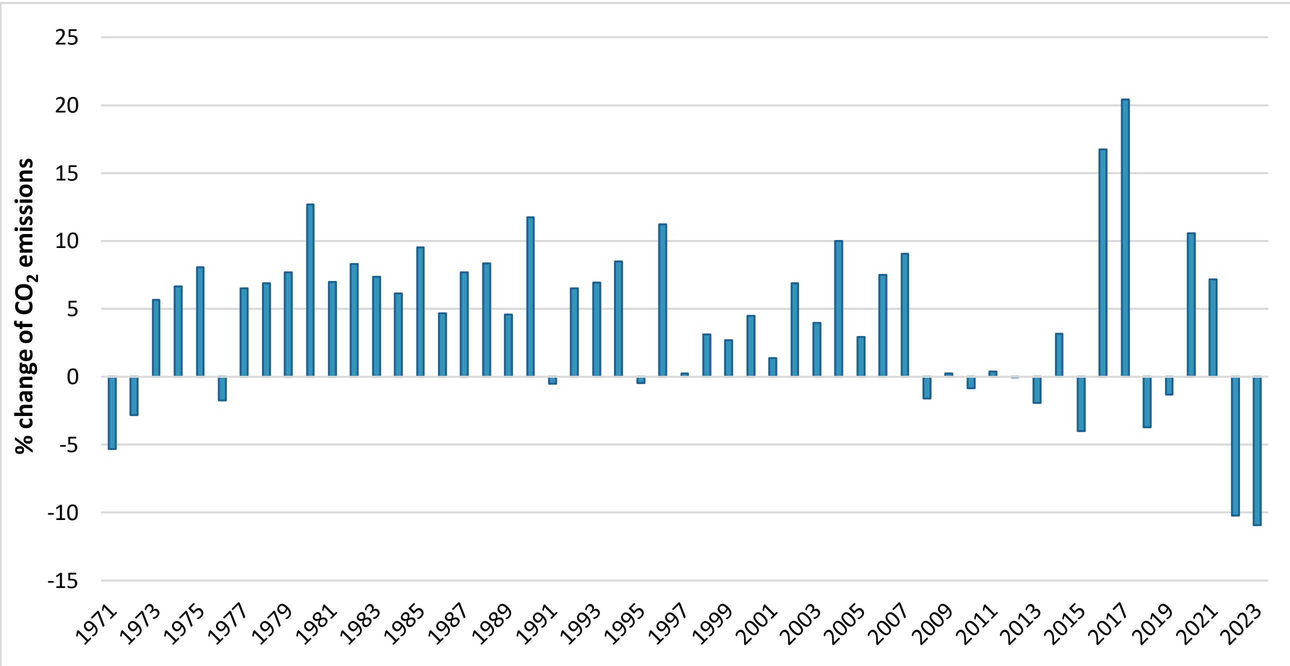

Figure 5: *Year-on-year change of CO_2 emissions of Pakistan.*

Comparative trends further reinforce this interpretation. As shown in Figure 6, Pakistan's energy intensity declined more slowly than in several regional peers, reflecting persistent inefficiencies in industrial production, transport, and power generation. Figure 7 indicates limited progress in reducing the carbon intensity of energy, particularly after 2010, coinciding with expanded coal use and continued reliance on oil and gas. Although Pakistan's per-capita CO_2 emissions remain below global and regional averages (Figure 8), the growth rate of emissions has been among the highest in South Asia, underscoring the difficulty of decoupling economic growth from emissions under existing policy regimes.

The evolution of Pakistan's primary energy mix, shown in Figure 9, highlights the role of investment incentives in shaping emissions outcomes. While hydropower and solar capacity expanded in absolute terms, their relative contribution remained limited due to regulatory uncertainty, grid integration challenges, and the absence of strong price signals favoring low-carbon generation. Fossil fuels continued to dominate due to guaranteed returns under power purchase agreements, fuel price pass-through mechanisms, and subsidies that lowered the effective cost of carbon-intensive energy. Together, these factors constrained the impact of renewable policies and contributed to the persistence of a carbon-intensive energy structure.

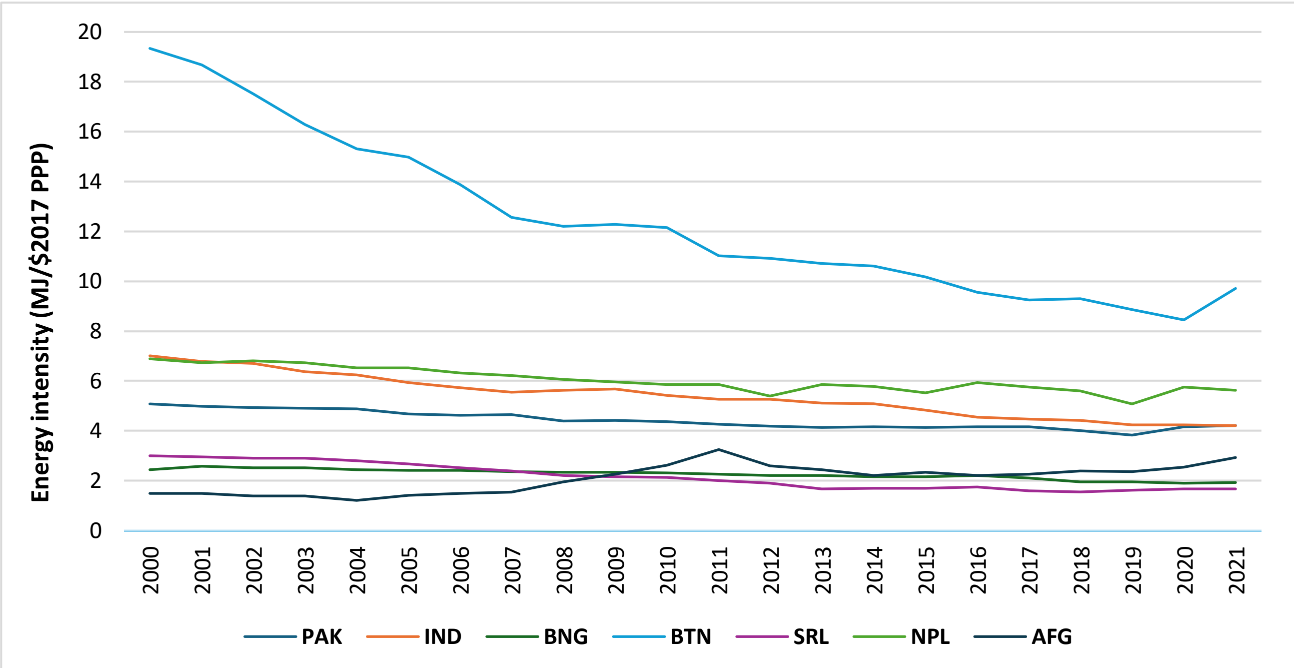

Figure 6: *Energy intensity trends in Pakistan and regional countries (2000–2021) (WDI, 2025).*

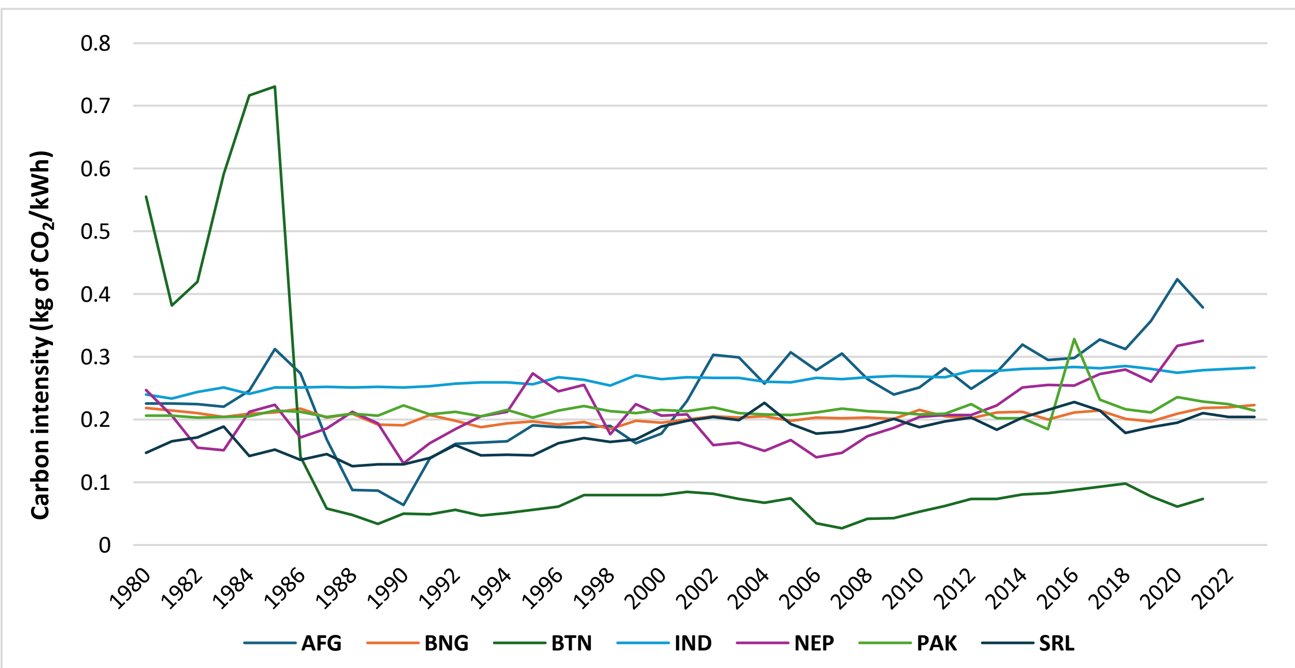

Figure 7: *Carbon intensity of energy systems in Pakistan and regional countries (1980–2022) (WDI, 2025).*

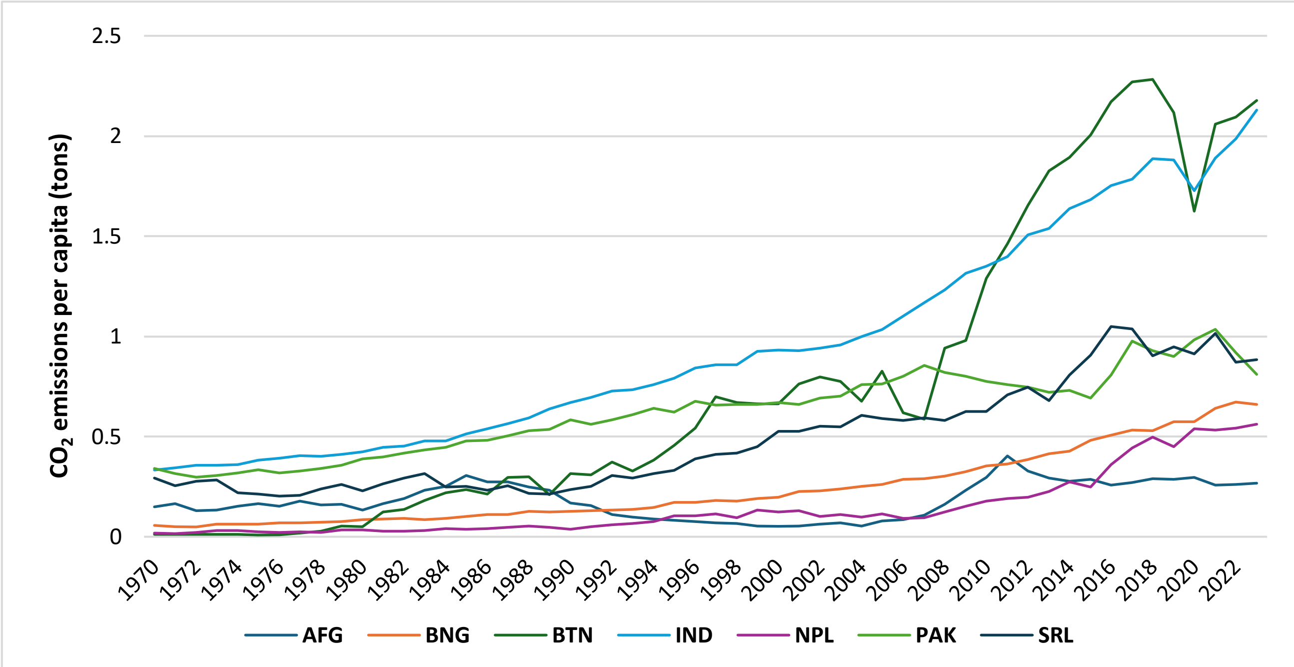

Figure 8: *Trends in CO_2 emissions per capita in Pakistan and regional countries (1970–2022) (WDI, 2025).*

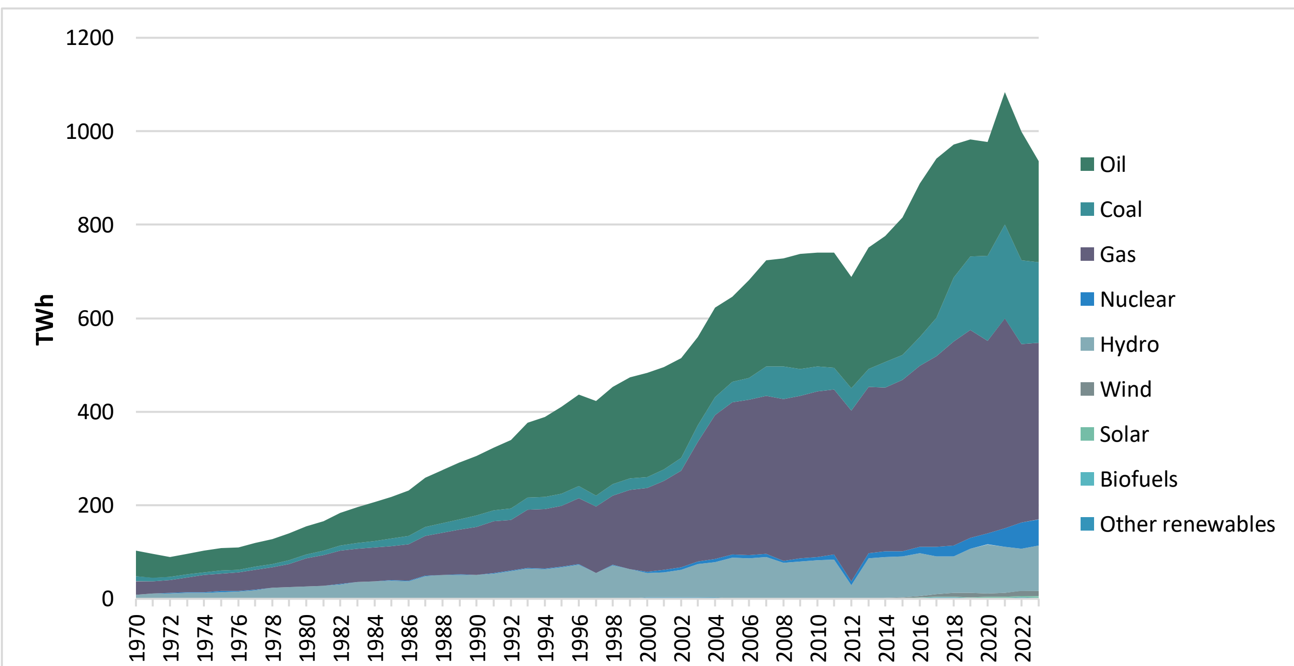

Figure 9: *Evolution of Pakistan's primary energy mix (1970–2022) (Our World in Data, 2025).*

The Kaya results demonstrate that emissions growth in Pakistan is not solely the product of demographic and economic expansion, but the outcome of a policy environment in which pricing distortions, fossil fuel subsidies, and investment incentives have weakened the responsiveness of the energy system to efficiency and decarbonization objectives. While incremental gains in energy efficiency were achieved, they were insufficient to offset rising demand under prevailing tariff and subsidy regimes. This misalignment between energy prices, fiscal policy, and emissions outcomes helps explain the continued rise in emissions despite formal sustainability commitments.

These findings highlight the need for policy instruments capable of correcting price distortions and aligning private incentives with social and environmental objectives. With more than 80% of Pakistan's GHG emissions originating from the energy sector, reforms that combine cost-reflective pricing with explicit carbon signals offer the greatest potential for altering emissions trajectories in a fiscally and economically efficient manner. The decomposition analysis provides an empirical foundation for examining market-based instruments, including carbon pricing, as mechanisms to address the policy design weaknesses underlying Pakistan's high-emissions growth path.

Section 4: Recent Trends in Emission Drivers (2000–2021)

This section provides a diagnostic assessment of Pakistan's recent emissions trajectory by examining the relative behavior of key drivers over the period 2000–2021. Indexed trends for CO_2 emissions, population, GDP per capita, energy intensity, carbon intensity, and primary energy consumption are presented in Figure 10, with all variables normalized to their 2000 levels to facilitate comparison of relative growth rates and interdependencies.

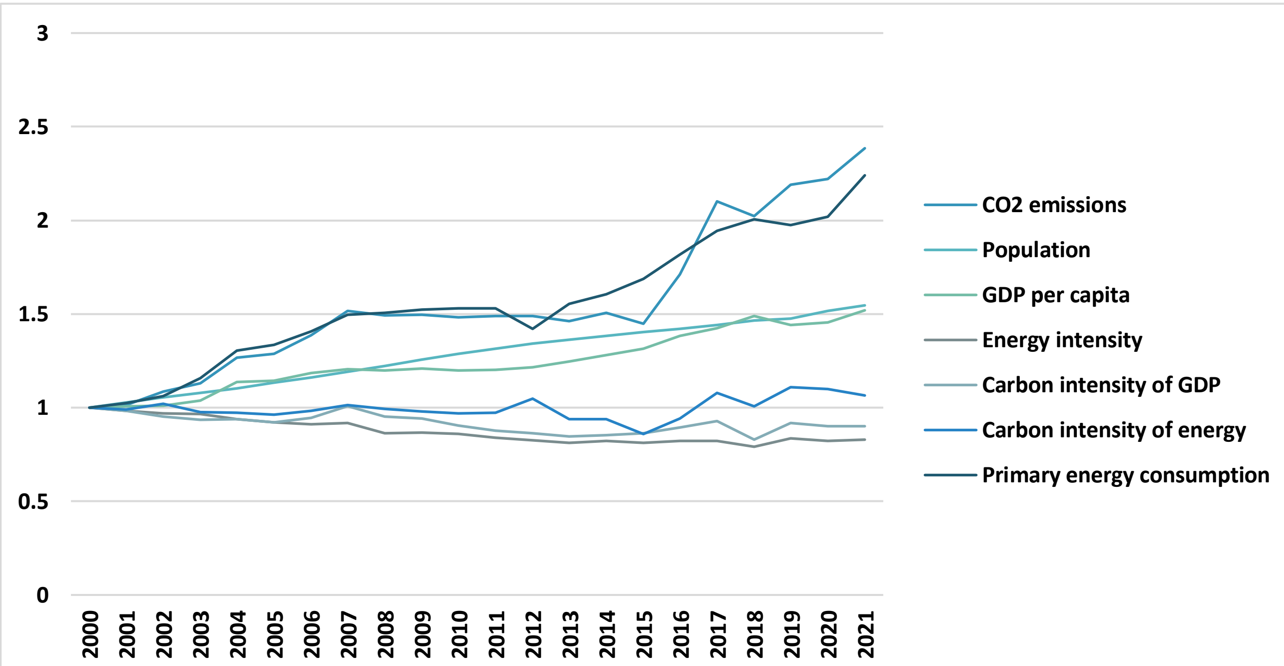

Figure 10: *Indexed Trends in key emission drivers in Pakistan (2000–2021).*

During 2000–2021, energy-related CO_2 emissions more than doubled relative to the 2000 baseline. Population growth and GDP per capita each increased by approximately 50%, yet emissions rose at a substantially faster pace. This divergence indicates that emissions growth cannot be explained by demographic or income expansion alone. The close alignment between CO_2 emissions and primary energy consumption suggests that the scale of energy demand remained the dominant determinant of emissions outcomes, with limited moderating influence from efficiency improvements or changes in fuel composition. Energy intensity declined by approximately 17% between 2000 and the mid-2010s, reflecting incremental gains in efficiency associated with technological upgrades, fuel substitution, and periods of constrained demand. However, these improvements plateaued after 2016, signaling the limits of efficiency gains achieved under prevailing policy and pricing structures. The absence of sustained post-2010 declines in energy intensity points to a broader pattern of policy and institutional inertia, where efficiency standards, enforcement mechanisms, and investment incentives were insufficient to drive continued structural improvement as energy demand expanded.

Trends in carbon intensity further reinforce the diagnosis of structural lock-in. Carbon intensity of energy exhibited only modest variation throughout the period, reflecting persistent reliance on oil, gas, and coal in the power and transport sectors. The limited responsiveness of carbon intensity to growing renewable capacity highlights the role of long-term investment commitments, generation dispatch rules, and pricing arrangements that favored fossil fuel-based generation. Additions of renewable capacity functioned largely as incremental supplements rather than transformative substitutes within the energy system. By contrast, the steady decline in the carbon intensity of GDP suggests some degree of economic diversification toward less emissions-intensive activities. However, this improvement did not translate into absolute emissions stabilization, as gains at the economy-wide level were offset by rising energy demand and the continued carbon intensity of the energy supply. This divergence underscores a key structural imbalance: while economic output became marginally cleaner, the energy system remained insufficiently responsive to decarbonization signals. Fluctuations in emissions and intensity indicators after 2010 also reflect the influence of external economic shocks and domestic constraints. Periods marked by energy shortages, balance-of-payments pressures, and fuel price volatility temporarily suppressed demand and emissions growth. These effects were short-lived and did not alter the underlying trajectory. Once constraints were eased, emissions rebounded, indicating that observed slowdowns were cyclical and not the result of sustained structural change.

These trends show that Pakistan's recent emissions trajectory reflects policy inertia and structural lock-in, interrupted by short-term economic shocks. Modest efficiency gains and incremental renewable deployment were insufficient to counter rising energy demand in the absence of stronger price signals and coordinated policy reform. The persistence of emissions growth despite improvements in selected indicators highlights the limitations of relying on isolated efficiency measures or sector-specific interventions. This diagnostic evidence underscores the need for economy-wide policy instruments capable of correcting systemic price distortions and realigning investment incentives that continue to anchor the energy system in a carbon-intensive path**.**

Section 5: Drivers for Carbon Mitigation in Pakistan

Carbon mitigation outcomes in Pakistan are shaped not only by structural emissions drivers, but also by political, economic, institutional, and legal conditions that influence policy design and implementation. To assess these conditions systematically, this section applies a PESTEL framework to examine the key drivers and constraints affecting the feasibility of carbon mitigation, with particular attention to carbon pricing in Pakistan. The analysis integrates observed emissions patterns with fiscal, institutional, and governance realities to identify leverage points for effective policy intervention. Carbon pricing is examined within the broader political economy of Pakistan's energy and fiscal systems, allowing mitigation instruments to be assessed in relation to existing pricing distortions, subsidy regimes, institutional capacity, and legal enforcement structures. By situating mitigation options within this wider context, the PESTEL framework enables a structured evaluation of how political incentives, economic constraints, administrative capabilities, technological readiness, environmental pressures, and legal frameworks interact to shape mitigation outcomes. Table 3 summarizes the key dimensions of this assessment, highlighting both enabling conditions and persistent barriers to effective carbon mitigation policy.

Table 3: *PESTEL analysis of carbon pricing feasibility in Pakistan.*

PESTEL Dimension	Key Variable(s)	Interpretation	Policy Implications
Political	Renewable energy consumption and tax revenue Fossil fuel consumption and tax revenue	Weak associations between renewable energy consumption and tax revenue ($r^2 = 0.128$), and between fossil fuel consumption and tax revenue ($r^2 = 0.1572$), are consistent with limited integration of environmental objectives into fiscal policy. These patterns suggest that energy pricing and taxation have not systematically internalized environmental externalities, reflecting governance and prioritization constraints rather than explicit policy design.	Highlights the potential role of carbon pricing and environmental fiscal instruments in strengthening the linkage between energy use and public revenue, while underscoring the importance of political commitment and institutional capacity for subsidy reform and pricing alignment.
Economic	GDP and GHG emissions GDP and tax revenue	The strong association between GDP and GHG emissions ($r^2 = 0.9772$) is indicative of a historically carbon-intensive growth trajectory. In contrast, the weak relationship between GDP and tax revenue ($r^2 = 0.1608$) suggests structural constraints in fiscal mobilization, including informality and limited tax compliance, which restrict the fiscal space available for climate action.	Indicates that carbon pricing could serve a dual role by moderating emissions growth while supporting revenue mobilization, provided broader tax administration and compliance reforms are pursued in parallel.

Social	Urban population and GHG emissions	The strong association between urban population growth and GHG emissions ($r^2 = 0.9633$) reflects the emissions intensity of urban expansion driven by transport demand, residential energy use, and infrastructure development. This pattern highlights the importance of urban form and service provision in shaping emissions outcomes.	Points to the need for integrating mitigation objectives into urban planning frameworks, including public transport investment, building efficiency standards, and demand-side energy management in rapidly growing cities.
Technological	R&D and environmental technologies Environmental technologies and emissions	Weak associations between R&D expenditure and environmental technologies ($r^2 = 0.0316$), and between environmental technologies and emissions ($r^2 = 0.0035$), suggest limited translation of research inputs into deployable mitigation technologies. This reflects early-stage adoption and weak commercialization pathways rather than technological irrelevance.	Highlights the importance of strengthening innovation ecosystems, including targeted R&D support, market incentives, and public–private partnerships, to enable clean technologies to contribute meaningfully to emissions reduction.
Environmental	Renewable energy share and GHG emissions Energy intensity and GHG emissions Energy consumption and GHG emissions Fossil fuel consumption and GHG emissions	Strong negative associations between renewable energy share and GHG emissions ($r^2 = 0.8108$), and between energy intensity and emissions ($r^2 = 0.6801$), indicate the mitigation potential of efficiency and fuel switching. Conversely, strong positive associations with energy consumption ($r^2 = 0.9654$) and fossil fuel use ($r^2 = 0.7943$) underscore the dominance of demand growth and carbon-intensive fuels in shaping emissions.	Reinforces the need for policies that simultaneously address energy demand, fuel mix, and pricing distortions, rather than relying on incremental renewable deployment alone.
Legal	Fossil fuel consumption and GHG emissions	The strong association between fossil fuel consumption and GHG emissions ($r^2 = 0.7943$) highlights the centrality of fossil fuels in emissions outcomes and points to limitations in existing regulatory controls. Weak enforcement capacity and the absence of binding carbon-pricing provisions constrain the effectiveness of current legal frameworks.	Suggests the importance of strengthening legal mandates for emissions control, including enforceable pricing, standards, and institutional authority, to support durable mitigation outcomes.

Section 6: Review of Existing Climate and Energy Policies

Pakistan's climate and energy policy framework has evolved in response to persistent challenges related to energy security, environmental degradation, and climate vulnerability. Over time, successive policies have sought to balance economic growth, sustainable development, and environmental objectives. While these policies articulate ambitious goals and reflect increasing awareness of climate risks, their effectiveness has been constrained by structural, institutional, and fiscal limitations that have limited their impact on emissions outcomes.

6.1 Energy Policies: Transition and System Constraints

Energy policy in Pakistan has historically prioritized supply expansion and energy security, with sustainability objectives incorporated more gradually. The Alternative Energy Development Board (AEDB) Act (2010) and the Alternative and Renewable Energy Policies of 2006 and 2019 represent key milestones in promoting renewable energy sources such as wind, solar, and hydropower. Despite these initiatives, renewable energy accounts for only about 13% of total electricity generation, reflecting persistent barriers related to grid integration, financing, and investment incentives. Broader power sector policies, including the National Power Policy (2013) and the Power Generation Policy (2015), have focused on increasing generation capacity through a mix of conventional and renewable sources. However, the continued expansion of coal-based generation and long-term power purchase agreements has reinforced fossil fuel dependence and limited flexibility in generation dispatch. These arrangements, combined with regulated tariffs below cost-recovery levels, have weakened price signals and constrained investment in efficiency and low-carbon alternatives. Energy efficiency initiatives, such as the National Energy Efficiency and Conservation Act (2016), aim to reduce demand growth by establishing standards for buildings, appliances, and industrial processes. In practice, weak enforcement, limited monitoring capacity, and fragmented institutional responsibilities have constrained their effectiveness. Similarly, net-metering and distributed generation regulations have enabled small-scale renewable deployment but remain limited by grid instability, transmission losses, and regulatory uncertainty.

6.2 Climate Policies: Institutionalization without Enforcement

Pakistan's climate policy architecture reflects growing recognition of both mitigation and adaptation imperatives. The National Climate Change Policy (2021) provides an overarching framework addressing climate risks across sectors such as agriculture, water, and coastal management, while reaffirming Pakistan's commitments under the Paris Agreement. Under its updated Nationally Determined Contributions (2021), Pakistan has pledged a 20% reduction in projected emissions by 2030 relative to business-as-usual levels, conditional on international support. Supporting instruments, including the Framework for Implementation of Climate Change Policy (2014–2030), outline sector-specific strategies for mitigation and adaptation. However, these frameworks lack clear operational targets, binding timelines, and robust monitoring mechanisms, limiting their capacity to drive measurable emissions reductions. The Climate Change Act (2017) represents an important step toward institutionalizing climate governance through the establishment of the Climate Change Council, yet its impact has been constrained by limited enforcement authority and resource allocation.

While these policies establish intent and institutional structures, their effectiveness is undermined by weak integration with energy pricing, fiscal policy, and investment frameworks. Climate objectives therefore often operate alongside, rather than being embedded within, core economic and energy decision-making processes.

6.3 Policy Fragmentation and the Absence of an Economy-wide Carbon Framework

Pakistan's energy and climate policies reflect a fragmented approach to emissions mitigation. Sector-specific initiatives in renewable energy, energy efficiency, and adaptation operate without a unifying mechanism to internalize the cost of carbon across the economy. In the absence of an explicit carbon management framework, emissions outcomes remain shaped primarily by energy demand growth, fossil fuel pricing, and fiscal constraints rather than by mitigation objectives. Carbon pricing instruments, including carbon taxes and emissions trading systems, are absent from the current policy architecture, despite their growing international use to align economic incentives with climate goals. Existing policies rely largely on administrative controls, subsidies, and project-based interventions, which have not altered long-term emissions trajectories. Pakistan's reliance on external climate finance to meet its NDC commitments further introduces uncertainty and delays, weakening policy credibility and continuity.

Table 4 summarizes Pakistan's stated targets, implemented measures, ongoing initiatives, and envisaged reforms. While the table highlights ambitious goals and a growing policy portfolio, it also illustrates the gap between aspiration and implementation. The absence of binding, economy-wide pricing signals and enforceable emissions targets remains a central limitation of the current framework, underscoring the need for integrated policy instruments capable of addressing structural drivers of emissions.

Table 4: *Overview of Pakistan's Climate and Energy Policy Targets, Implemented Measures, Ongoing Initiatives, and Planned Objectives.*

Category	Details for Pakistan
Targets Defined	- Increase share of renewable energy to 30% by 2030 (National Electricity Policy, 2021)
	- Achieve net-zero emissions by 2050, with interim targets for 2030 and 2040 (LT-LEDS)
	- Reduce carbon intensity and promote clean energy technologies (Pakistan's NDCs, 2021)
	- Expand hydro, solar, wind, and nuclear power capacity
Measures Already Implemented	Policy/Regulatory: Feed-in Tariffs (FiT) & net metering policies for solar/wind
	- Renewable Energy Policy 2019 to promote private sector investment
	Financial Incentives: Tax exemptions & customs duty waivers on renewable energy
	- Removal of some fossil fuel subsidies (limited reforms)
	Legislation: Environmental Protection Act includes taxes on emissions and pollutants
	- Pakistan Emissions Trading Scheme (pilot phases discussed)

Work "In Progress"	- Development of a national GHG emissions inventory (completion expected by 2025)
	- Gradual phasing out of fossil fuel subsidies (fuel price increases in line with global trends)
	- Expansion of Climate Change Act implementation and sector integration
	- Market-based mechanisms (carbon pricing/carbon tax discussions underway)
	- Emerging EV infrastructure and incentives for clean transport
Envisaged Measures	- Establish carbon pricing mechanisms (carbon tax or cap-and-trade) by 2025
	- Transition to market-reflective energy prices and removal of subsidies by 2030
	- Scale-up clean energy technologies (solar, wind, green hydrogen) through innovation and collaboration
	- Public-private partnerships for green infrastructure & technology transfer
	- Institutional reforms for energy sector efficiency and improved governance
	- Integrating climate resilience into national development plans

Section 7: Policy Options for Carbon Pricing in Pakistan

7.1 The Policy Challenge

Pakistan faces two interlinked policy challenges in addressing climate change. First, it must curb carbon-intensive production and local air pollutants such as $PM_{2.5}$ and NO_x while sustaining economic growth and structural transformation. Second, it must mobilize fiscal resources to finance climate adaptation, social protection, and investments required for a low-carbon transition. The analysis presented in earlier sections shows that emissions growth in Pakistan has been driven primarily by rising energy demand and continued reliance on fossil fuels, reinforced by pricing distortions and institutional constraints, not by a lack of policy intent.

Recent policy discussions on carbon pricing in Pakistan have also been influenced by the International Monetary Fund's Resilience and Sustainability Facility, which draws on mitigation pathways and carbon-pricing assumptions developed in the World Bank's Country Climate and Development Report. While these frameworks play an important role in macro-fiscal planning and conditional lending, the present analysis complements them by focusing on emissions diagnostics, institutional readiness, and political economy constraints that shape the feasibility and sequencing of carbon-pricing instruments in practice. This paper does not propose alternative price levels. Instead, it provides an implementation-focused assessment of how carbon pricing reforms could be operationalized under Pakistan's administrative and governance conditions.

Carbon pricing instruments offer a policy-relevant response because they address the price signals that shape energy use and investment decisions. International experience shows, however, that their effectiveness depends on institutional readiness, sequencing, and governance capacity, not on instrument choice alone. For Pakistan, the central question is therefore how and in what sequence carbon pricing instruments can be introduced in a manner consistent with existing administrative capacity and political economy constraints.

7.2 Addressing the External Costs of Carbon

Carbon emissions impose substantial social costs that are not reflected in market prices, including adverse health outcomes, productivity losses, infrastructure damage from climate-related disasters, and heightened food and water insecurity. In the absence of pricing mechanisms, these external costs are implicitly borne by households and the public sector, leading to inefficiently high fossil fuel consumption and underinvestment in low-carbon alternatives (Riaz et al., 2022). Carbon pricing addresses this market failure by incorporating the cost of emissions into economic decision-making. Within this paper carbon pricing is treated as a corrective policy instrument, not as an empirically demonstrated outcome of the emissions analysis itself. The empirical findings identify the structural drivers of emissions and the persistence of distorted price signals; carbon pricing is evaluated as a policy option that is conceptually well aligned with correcting these distortions and mobilizing resources for mitigation and adaptation.

7.3 Carbon Pricing Mechanisms: Overview

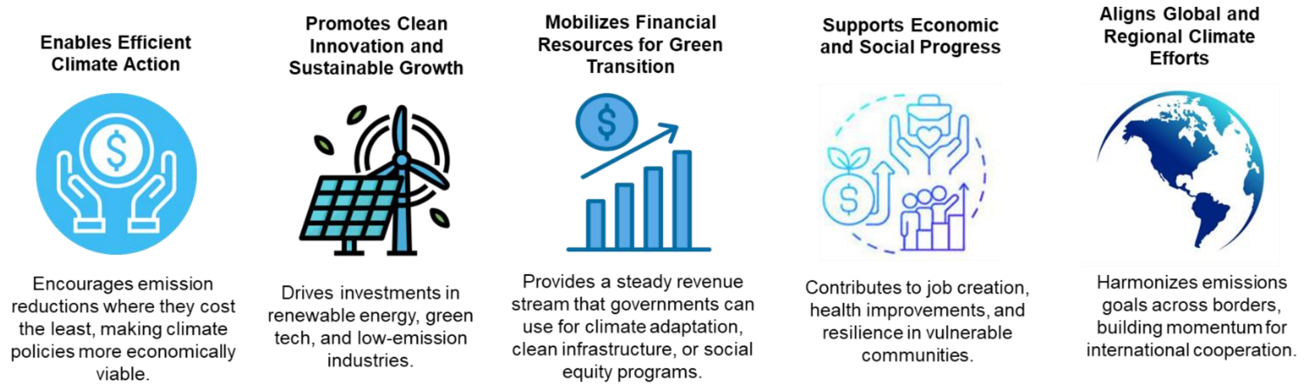

Figure 11: *Key benefits of carbon pricing mechanisms.*

Carbon pricing can be implemented through several instruments that differ in their administrative complexity, information requirements, and distributional implications. For Pakistan, three mechanisms are most relevant: carbon taxes, emissions trading systems (ETS), and crediting mechanisms. These instruments should be viewed as complementary tools suited to different stages of institutional development.

- Carbon taxes place a fixed charge on emissions or on the carbon content of fossil fuels. Their primary advantage lies in administrative simplicity and price certainty. Since Pakistan already levies excise duties and fuel taxes across the energy sector, a carbon tax could be implemented by building on existing fiscal infrastructure, limiting initial administrative burdens. While a carbon tax provides a clear price signal, it does not guarantee a specific emissions outcome and requires careful revenue recycling to address equity concerns (World Bank, 2024).
- ETSs establish a quantitative cap on emissions and allow regulated entities to trade allowances. This approach offers environmental certainty but requires strong institutional capacity, including comprehensive emissions monitoring, reporting and verification systems, legally enforceable caps, and credible compliance mechanisms. The assessment in Sections 5 and 6 indicates that Pakistan currently faces constraints in these areas, suggesting that an economy-wide ETS is better viewed as a medium to long-term objective than as an immediate policy option (World Bank, 2024).
- Crediting mechanisms provide incentives for verified emissions reductions from specific projects or sectors that are difficult to regulate directly, such as agriculture, forestry, or distributed energy systems. Under the Paris Agreement, the Clean Development Mechanism has been replaced by Article 6.4 mechanism administered under the UNFCCC. For Pakistan, crediting mechanisms aligned with Article 6.4 can provide access to international carbon markets, support private investment, and contribute to the development of domestic monitoring and verification capacity without imposing economy-wide compliance obligations (World Bank, 2024).

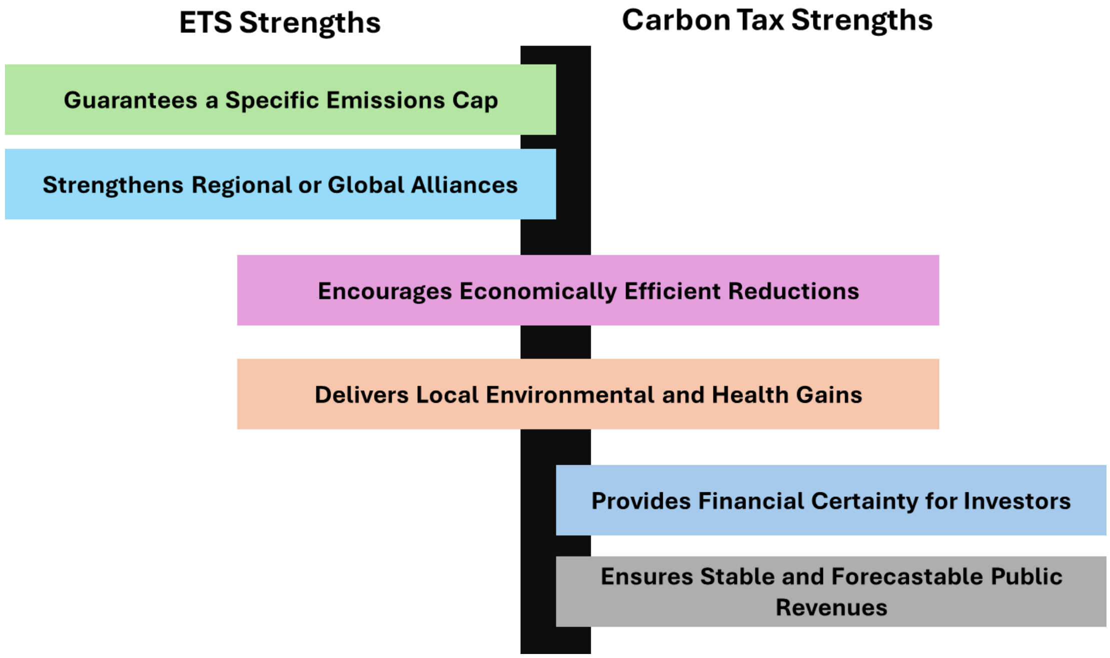

Figure 12: *Considering objectives and potential preference for ETS or carbon tax.*

Global Experience and Relevance for Pakistan

International experience illustrates the importance of aligning instrument choice with institutional readiness:

- The **European Union ETS**, launched in 2005, demonstrates the potential of cap-and-trade systems in jurisdictions with strong regulatory capacity and mature MRV systems.
- **China's national ETS**, operational since 2021, illustrates a phased approach, beginning with limited sectoral coverage and gradually strengthening enforcement and data quality.
- **Article 6.4 crediting mechanisms** under the Paris Agreement provide a framework for developing countries to generate internationally recognized mitigation outcomes while strengthening domestic MRV and governance capacity.
- According to the World Bank (2022), carbon taxes have been adopted or considered in 28 national and 8 sub-national jurisdictions, reflecting their relative administrative feasibility, particularly in countries with existing fuel taxation systems.

These experiences suggest that **sequencing matters**. Countries that have successfully implemented complex trading systems typically began with simpler instruments or pilot phases, allowing institutions to mature over time.

Policy Guidelines for Carbon Markets (2024)

Pakistan has recently issued the *Policy Guidelines for Carbon Markets (2024)*, marking the first structured attempt of the country to develop both voluntary and compliance-based carbon trading schemes. Aligned with

Article 6 of the Paris Agreement, the Guidelines propose the creation of a National Carbon Registry, standardized measurement, reporting and verification (MRV) systems, and a Carbon Market Working Group to coordinate implementation. If operationalized, these measures would provide the institutional backbone for Pakistan's entry into international carbon markets while also creating domestic opportunities for emissions trading. Independent analyses such as IPRI, 2025 (Salman & Yar, 2025) highlight significant implementation challenges. Bureaucratic inefficiencies such as lengthy approval processes for No Objection Certificates and Letters of Intent and overlapping mandates between federal and provincial agencies risk delaying project authorization. Weak enforcement provisions, including the absence of stringent penalties for non-compliance, further constrain the credibility of the framework. Equally pressing are gaps in private-sector incentives and financial governance. Without tax exemptions, concessional financing, or targeted subsidies, large-scale investment in low-carbon projects is unlikely. Ambiguities in revenue allocation, Corresponding Adjustment Fees, and the lack of a clear grievance redressal mechanism could erode investor confidence. Strengthening the effectiveness of the Guidelines requires embedding them within a broader fiscal and sectoral reform agenda. Priority actions include establishing a single-window approval system, creating transparent and traceable revenue allocation channels, and clarifying coordination among the Ministry of Climate Change, the Ministry of Finance, and provincial climate units. Targeted incentive programs, including green bonds, concessional loans, or tax credits, will be essential to mobilize private investment. Building domestic technical expertise will also reduce reliance on external consultants and support long-term institutional sustainability. With these reforms, the 2024 Guidelines could evolve from an advisory framework into the foundation of a credible and operational carbon market that supports Pakistan's low-carbon transition and expands access to climate finance.

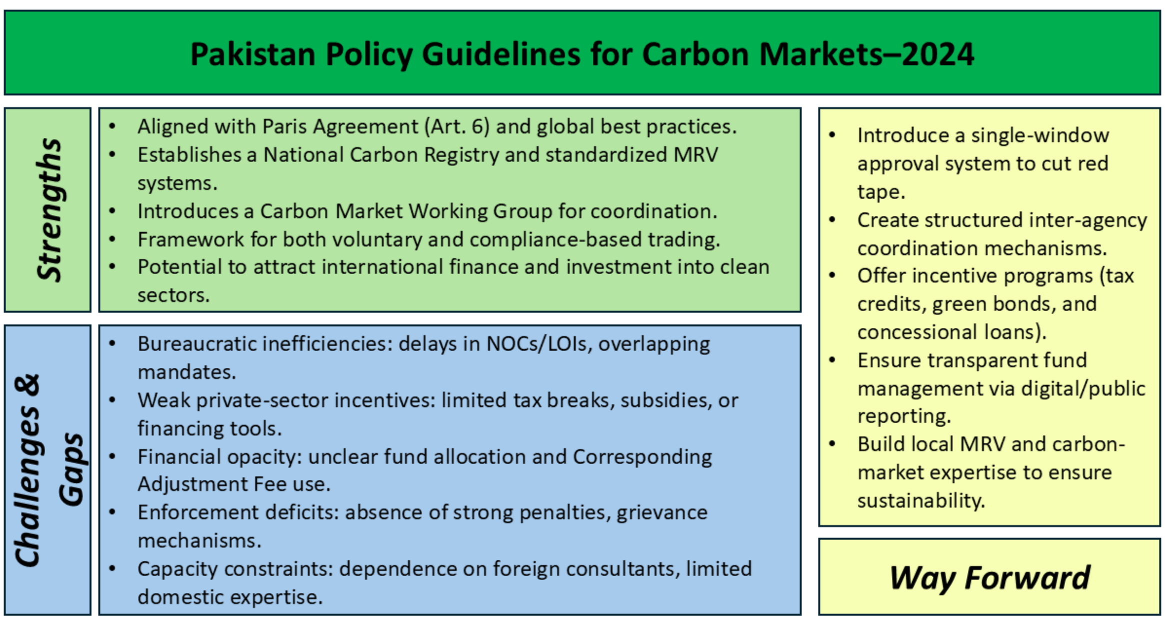

Figure 13: *Policy Guidelines for Carbon Markets (2024) of Pakistan - Strengths, challenges, gaps, and way forward.*

7.4 Analytical Overview of Carbon Pricing Options for Pakistan

An analytical assessment using Kingdon's Multiple Streams Framework was conducted to evaluate the policy feasibility of carbon pricing in Pakistan. This framework explains how climate risks constitute the problem stream, available mitigation instruments form the policy stream, and emerging political attention shapes the political stream. Figure 14 illustrates the convergence of these streams, indicating that Pakistan is at a juncture where carbon pricing mechanisms such as carbon taxes, emissions trading systems, and crediting approaches can be institutionalized.

Institutional readiness for carbon pricing can be evaluated against three threshold conditions. First, reliable measurement, reporting and verification systems are required for major emitting sectors to ensure credibility and compliance. Second, a clear legal and regulatory framework is needed to support enforcement, define liabilities, and enable dispute resolution. Third, sufficient administrative and fiscal capacity must exist to manage revenue collection, recycling, allowance allocation, or credit issuance in a transparent and accountable manner. While recent progress has been made, including through the carbon market guidelines, these thresholds have not yet been met at the level required for an economy-wide emissions trading system. This reinforces the case for a phased approach.

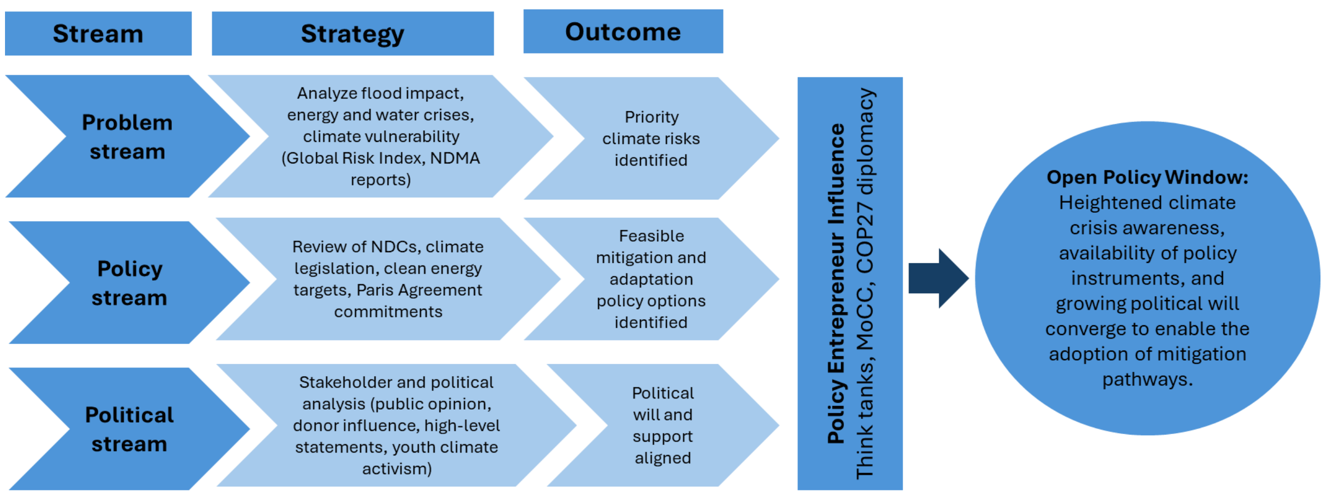

Figure 14: *Convergence of Kingdon's Multiple Streams for carbon pricing reform in Pakistan.*

Within Pakistan's socio-economic structure and institutional capacity, the choice of carbon pricing instruments must balance feasibility, equity, and environmental effectiveness.

A carbon tax represents the most practical and near-term option for Pakistan. Leveraging the existing fuel taxation system can reduce implementation complexity and administrative costs while providing a stable and predictable price signal. A carbon tax can also generate fiscal revenues that may be recycled to protect vulnerable households and support clean energy investment. Experiences from South Africa, where phased implementation was combined with compensatory measures for low-income groups, and Colombia's fuel-based carbon tax, which supports social and environmental programs, offer relevant lessons (International Monetary Fund, 2023; Herrera, 2023).

The carbon levy introduced in the FY2024 to FY2025 federal budget highlights both the opportunities and design risks associated with carbon pricing in Pakistan. The levy signals recognition that emissions impose economic and social costs and demonstrates the feasibility of implementation through existing fiscal instruments. At the same time, its effectiveness as a climate policy depends on revenue governance. The absence of explicit earmarking has raised concerns that the levy could be perceived primarily as a revenue-raising measure rather than as part of a broader decarbonization strategy, with distributional implications for lower- and middle-income households.

Pakistan has an existing institutional mechanism capable of addressing these concerns in the form of the Pakistan Climate Fund established under the Climate Change Act of 2017. Channeling carbon levy revenues through this fund would provide a transparent and legally grounded pathway for linking revenues to mitigation, adaptation, and social protection objectives. Such an arrangement could strengthen policy credibility, reduce regressive impacts through targeted spending, and position the levy as an integral component of an evolving carbon pricing architecture.

To enhance legitimacy and effectiveness, carbon levy revenues should be transparently recycled into:

- clean energy investments, including renewable generation, grid upgrades, and energy efficiency programs
- targeted social protection measures, such as lifeline electricity tariffs, direct cash transfers, or support for clean cooking fuels
- green jobs and reskilling programs to support employment in emerging low-carbon sectors

Robust monitoring and reporting systems are essential to demonstrate that revenues are being deployed as intended. Explicitly linking the levy to Pakistan's climate commitments and just transition objectives would strengthen its role as a credible climate policy instrument.

Carbon Levy 2024–25: Risks and Reform Priorities

Opportunities

- Demonstrates the government's willingness to price emissions through fiscal measures.
- Quick to implement by leveraging existing fuel tax collection systems.
- Could serve as a transitional step toward a comprehensive carbon tax regime.
- Potential to generate significant revenues that can support climate and social objectives.

Risks & Criticisms

- Widely viewed as a revenue-generation tool, not a genuine climate instrument.
- No earmarking of revenues for environmental or social programs undermines legitimacy.
- Risks being regressive, disproportionately affecting low- and middle-income households facing high energy costs.
- Absence of transparent reporting mechanisms raises concerns about accountability and misuse of funds.
- Could erode public trust in carbon pricing, making it harder to implement more ambitious measures later.

Reform Priorities

- **Revenue Recycling:** Direct levy proceeds into renewable energy, energy efficiency, and clean technology deployment.
- **Social Protection:** Allocate funds for lifeline electricity rebates, clean cooking subsidies, or direct cash transfers to protect vulnerable households.
- **Green Jobs & Transition:** Invest in workforce reskilling, training, and employment programs in low-carbon industries.
- **Transparency & Accountability:** Establish public reporting of revenue collection and spending, supported by independent audits.
- **Policy Integration:** Link the levy explicitly to Pakistan's NDC and just transition commitments, reframing it as a climate measure rather than a narrow fiscal tax.

The ETS offers greater environmental certainty by capping total emissions, encouraging the most cost-effective emission reductions via market trading. However, ETS requires robust legal frameworks, advanced MRV systems, and institutional capacity, areas where Pakistan needs development. Piloting ETS in key sectors such as power and cement, as China (International Energy Agency, 2024) and Mexico (International Carbon Action Partnership, 2024) have done, can build experience and capacity progressively, making it a strong medium-to-long-term strategy for Pakistan.

Crediting mechanisms offer a complementary tool to address sectors difficult to regulate directly, such as agriculture and forestry. By generating tradable credits for verified emission reductions, they incentivize private investment in rural and low-carbon technologies, supporting livelihoods and sustainable development goals. India's Perform, Achieve, and Trade scheme for energy efficiency and Kenya's forestry carbon projects under voluntary markets offer replicable models (Kenya National Environment Management Authority, 2023). Effective governance and MRV capacity development are critical for safeguarding environmental integrity and market confidence.

In practical terms, this implies a clear sequencing of instruments: an initial phase centered on a carbon tax and voluntary crediting mechanisms to establish price signals and MRV capacity, followed by the gradual introduction of sectoral or economy-wide emissions trading once institutional, legal, and data systems have sufficiently matured.

An Integrated and Phased Approach combining these instruments is most suited to Pakistan's circumstances. Beginning with a carbon tax and voluntary crediting to build institutional foundations and public acceptance, Pakistan can incrementally develop an ETS covering major emitters. This phased approach balances ambition with practicality, leverages international experience, and aligns with Pakistan's NDCs under the Paris Agreement. Successful implementation will depend on transparent governance, equitable revenue use, and complementary policies fostering green technology uptake and social protection.

Table 5: *Comparative analysis of carbon pricing policy options for Pakistan.*

Policy Option	Key Merits	Key Demerits	Relevance & Considerations for Pakistan
Carbon Tax	- Simple to administer using existing tax systems. - Provides price certainty for businesses. - Generates predictable government revenue. - Can be phased in gradually. - Reduces emissions and local air pollution.	- Emission reductions are uncertain and depend on price elasticity. - Risk of disproportionate impact on low-income groups without compensation. - Political resistance from energy-intensive sectors. - May not incentivize innovation beyond a set price.	- Best immediate option to start carbon pricing. - Utilize existing fuel levy system to minimize administrative burden. - Revenue recycling to protect low-income households essential. - Initial low rates with gradual increases recommended.
Emissions Trading System (ETS)	- Guarantees emission reduction targets through caps. - Allows cost-effective reductions via trading. - Incentivizes innovation and early reductions.	- Complex and costly to set up and manage. - Requires robust MRV and legal frameworks. - Risk of price volatility.- Limited market liquidity in initial phases. - Requires strong institutional capacity.	- Suitable medium-to long-term option. - Start with pilot sectors like power and cement. - Develop robust emissions monitoring and registry.- Use carbon tax experience as foundation.

	- Price adjusts automatically with market conditions. - Potential for linking with other carbon markets.		- Enables Pakistan to meet NDC targets efficiently.
Crediting Mechanisms	- Promotes emissions reduction in hard-to-regulate sectors (agriculture, forestry). - Mobilizes climate finance and private investment. - Supports rural livelihoods and green development. - Flexible and scalable approach.	- Complex verification and risk of double counting. - Relies on demand in voluntary or compliance markets. - May concentrate benefits among project developers. - Needs strong MRV and governance to ensure integrity.	- Ideal to incentivize mitigation in agriculture and forestry. - Supports Pakistan's rural economy and SDGs. - Can complement carbon tax and ETS. - Requires capacity building for MRV and registry development.
Integrated/Phased Approach	- Matches Pakistan's institutional capacity and economic realities. - Allows gradual expansion and adaptation. - Balances environmental ambition with political economy. - Facilitates learning and stakeholder buy-in.- Aligns with international climate commitments.	- Requires strong inter-agency coordination. - Potential overlap and complexity if not well managed. - Political resistance may persist. - Needs consistent long-term policy commitment.	- Most pragmatic path forward for Pakistan. - Begin with carbon tax and voluntary credits. - Build ETS capacity in pilot sectors. - Use revenues strategically for social protection and green investment. - Ensures sustainable, comprehensive carbon pricing regime.

7.5 Social Dimension: Energy Security and a Just Transition

Carbon pricing in Pakistan cannot be evaluated solely through fiscal or environmental lenses. For such instruments to gain political legitimacy and long-term durability, they must deliver visible social benefits, strengthen energy security, and address distributional concerns. International experience shows that carbon-pricing reforms are most effective when embedded within broader social frameworks that emphasize equity, transparency, and revenue recycling (IMF, 2019; OECD, 2023; World Bank, 2022).

The Social Cost of Carbon (SCC) as a Normative Benchmark

Within this social framework, the SCC is introduced strictly as a normative and analytical benchmark, not as an immediately implementable carbon price. The SCC represents an estimate of the monetized damages associated with emitting one additional ton of CO_2, encompassing impacts on public health, agricultural productivity, labor output, and climate-related disasters such as floods and heatwaves. In policy analysis, it provides a reference point for assessing the adequacy and ambition of climate policies rather than prescribing near-term price levels. Recent estimates place the Social Cost of Carbon at approximately USD 190 per ton of CO_2 in 2020 dollars, rising to around USD 260 per ton by the mid-2020s as climate damages intensify (Bledsoe et al., 2024; Rennert et al., 2025). Applied illustratively to Pakistan's 2023 emissions of roughly 200 million tons of CO_2, these values imply annual social damages of approximately USD 38 to 52 billion, equivalent to about 10 to 13 percent of GDP. These figures are presented only to indicate the scale of unpriced social costs and should not be interpreted as recommended tax rates or near-term policy targets. They illustrate the extent to which climate-related damages are already borne implicitly by households through health expenditures, livelihood losses, and infrastructure damage. The SCC therefore reframes carbon pricing as a corrective policy tool aimed at narrowing the gap between private energy costs and broader social damages over time. For Pakistan, these estimates are best used to inform the long-term direction and ambition of carbon pricing, while actual price levels must remain grounded in domestic economic conditions, institutional capacity, and social acceptability.

Energy Security and Macroeconomic Stability

Pakistan's energy system remains highly exposed to external shocks. More than 60% of national energy demand is met through imported fossil fuels, which account for nearly one-third of the total import bill (Pakistan Economic Survey, 2023). This dependence exposes the economy to fuel-price volatility, foreign-exchange pressures, and supply disruptions, while high transmission losses and persistent circular debt undermine fiscal stability. When designed appropriately, carbon-pricing revenues can help mitigate these vulnerabilities by financing renewable energy deployment, grid modernization, and energy-efficiency programs. Over time, such investments can reduce import dependence, stabilize energy costs, and enhance economic resilience, positioning carbon pricing as a tool not only for emissions mitigation but also for energy security and macroeconomic stability (World Bank, 2023).

Equity and Distributional Considerations

Equity considerations are central to the political feasibility of carbon pricing in Pakistan. Low- and lower-middle-income households devote a disproportionate share of income to energy and food, leaving them particularly vulnerable to price increases. More than one-quarter of the population lives below the poverty line, and inflationary pressures have already strained household budgets (Pakistan Bureau of Statistics, 2023). The carbon levy introduced in the FY 2024–25 federal budget illustrates these challenges. While it signaled a shift toward emissions pricing, the absence of explicit revenue earmarking weakened public acceptance and raised concerns about regressivity (SDPI, 2025). International experience suggests that such outcomes can be avoided when revenues are transparently recycled into targeted social protection measures, including lifeline electricity tariffs, cash transfers through existing safety nets such as BISP, and subsidies for clean cooking fuels. Complementary investments in rooftop solar, affordable electric transport, and energy-efficient housing can further distribute the benefits of decarbonization. A socially sustainable carbon-pricing strategy must also anticipate labor-market adjustments. Carbon-intensive sectors such as coal-based power generation, cement, and heavy industry employ significant numbers of workers, often concentrated regionally. Establishing a Just Transition Fund, financed in part through carbon-pricing revenues, can support retraining, reskilling, and job placement in emerging low-carbon sectors, reducing the risk of localized economic disruption (ILO, 2021; OECD, 2022).

Governance, Transparency, and Public Trust

The durability of carbon pricing ultimately depends on governance. Transparent revenue management, independent audits, and regular public reporting are essential for sustaining public trust (OECD, 2023). For Pakistan, carbon pricing must be framed as a social contract in which revenues collected from emissions visibly translate into cleaner air, more reliable energy, and strengthened social protection. Embedding transparency and accountability into pricing mechanisms is therefore not ancillary, but central to their success.

The Triple Dividend

When anchored in equity, transparency, and energy-security objectives, carbon pricing can deliver a triple dividend: environmental gains through emissions reduction, economic benefits through improved fiscal stability and reduced import dependence, and social dividends through fairer distribution of costs and opportunities. Viewed through this lens, the Social Cost of Carbon serves not as a prescriptive price, but as a benchmark underscoring the scale of unpriced damages and the long-term case for aligning Pakistan's development pathway with a just and resilient low-carbon transition.

Section 8: Conclusions

Pakistan stands at a critical juncture where rapid socio-economic development and rising energy demand are driving sustained growth in GHG emissions, even as the country remains among the most climate-vulnerable globally. This working paper demonstrates that population growth and economic expansion have been the dominant contributors to emissions growth over the past five decades, while improvements in energy efficiency and renewable energy deployment have remained insufficient to offset rising demand. These findings underscore the limitations of fragmented, sector-specific interventions and highlight the need for an integrated, economy-wide carbon policy framework.

This paper makes three distinct contributions to Pakistan-focused climate and energy policy literature. First, it links long-run empirical emissions diagnostics with the political economy of policy design. Much of the existing literature examines energy policy, climate vulnerability, or mitigation instruments separately. This study integrates emissions decomposition, recent trend diagnostics, and institutional analysis to explain why emissions have continued to rise despite formal policy commitments and to identify the policy design failures that have had the greatest impact. By situating emissions outcomes within pricing distortions, fossil fuel subsidies, fiscal constraints, and institutional capacity, the analysis advances a systemic understanding of Pakistan's carbon challenge.

Second, the paper contributes to the policy debate by outlining a sequenced pathway for carbon pricing that reflects Pakistan's institutional context. Carbon taxes, emissions trading systems, and crediting mechanisms are not treated as interchangeable instruments. Their functional roles, administrative requirements, and timing are differentiated. The analysis shows that a carbon tax, built on existing fuel levy systems, represents the most feasible entry point in the near term. Crediting mechanisms under Article 6.4 can mobilize private investment in sectors that are difficult to regulate directly. An emissions trading system emerges as a medium to long-term objective, contingent on stronger measurement, reporting and verification systems, legal enforcement, and regulatory capacity. This sequencing offers a practical roadmap that connects policy ambition with institutional feasibility.

Third, the paper reframes carbon pricing as a development instrument, not solely as a fiscal or environmental measure. By linking pricing reforms to energy security, equity, and just transition considerations, and by using the Social Cost of Carbon as a normative benchmark rather than a prescriptive price level, the analysis shows how carbon pricing can support macroeconomic stability, reduce import dependence, and strengthen social protection when revenues are recycled transparently and equitably. The findings indicate that Pakistan's emissions trajectory reflects policy design choices that have weakened price signals and investment incentives, not an unavoidable consequence of economic growth.

Way Forward: Strengthening Inclusive Financing for Carbon Pricing

Building on these findings, the paper identifies inclusive financing as a critical enabler for translating carbon pricing into durable development outcomes. Public revenues generated through carbon taxes or levies can be used strategically to de-risk private investment in renewable energy, grid modernization, and energy efficiency through instruments such as green bonds, public private partnerships, and concessional lending. International experience from India's sovereign green bonds and Bangladesh's Infrastructure Development Fund illustrates how public finance can catalyze private capital for low-carbon infrastructure.

Pakistan could adapt these approaches by establishing a National Green Transition Fund governed through a multi-stakeholder framework and financed in part by carbon pricing revenues. Such a fund could support clean energy deployment, grid upgrades, and targeted social protection measures while ensuring transparency, accountability, and measurable outcomes. When combined with streamlined permitting processes, capacity building for financial institutions, and incentives for green technology adoption, inclusive financing can transform carbon pricing from a standalone policy instrument into a core pillar of Pakistan's just, resilient, and sustainable low-carbon transition.

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