CARBON CREDIT OPPORTUNITIES IN PAKISTAN

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List of Abbreviations

Abbreviation	Full Form
AFOLU	Agriculture, Forestry and Other Land Use
ARR	Afforestation, Reforestation and Revegetation
BESS	Battery Energy Storage Systems
BTR	Biennial Transparency Report
CAF	Corresponding Adjustment Fee
CCBS	Climate, Community and Biodiversity Standards
CDM	Clean Development Mechanism
COD	Chemical Oxygen Demand
CPPA-G	Central Power Purchasing Agency – Guaranteed
ERPA	Emissions Reduction Purchase Agreement
EV	Electric Vehicle
EF	Emission Factor
GHG	Greenhouse Gas
GWh	Gigawatt Hour
GCC	Global Carbon Council
ITMO	Internationally Transferred Mitigation Outcome
IPPU	Industrial Processes and Product Use
IoT	Internet of Things
KE	K-Electric
MW	Megawatt
MRV	Monitoring, Reporting and Verification

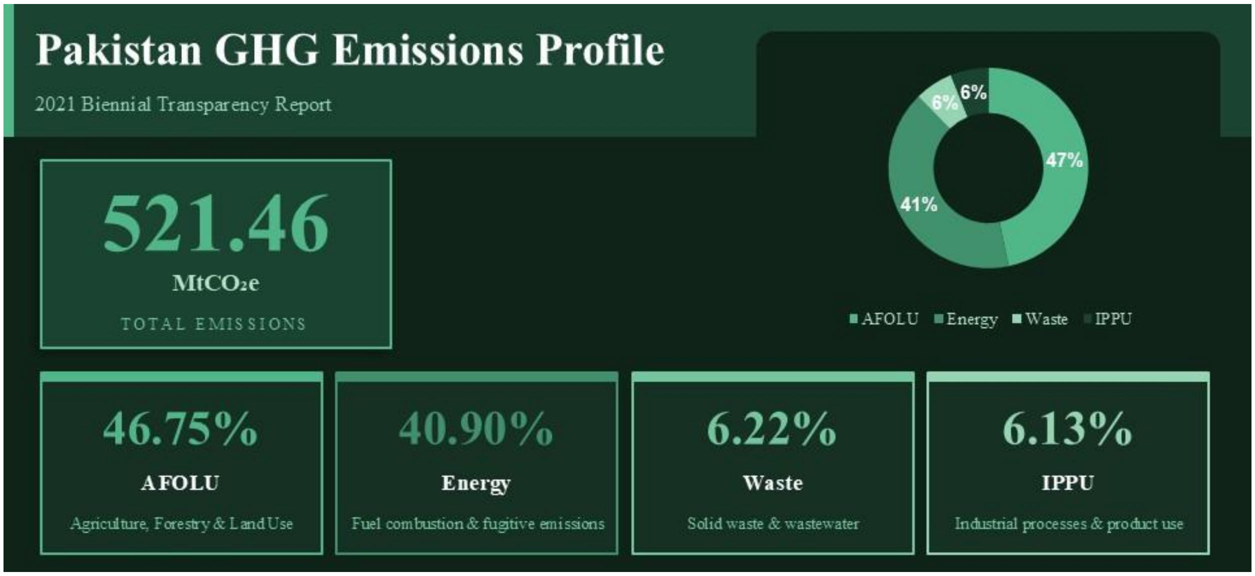
MSW	Municipal Solid Waste
NAMA	Nationally Appropriate Mitigation Action
NDC	Nationally Determined Contribution
NEPRA	National Electric Power Regulatory Authority
OTC	Over-the-Counter
PDD	Project Design Document
PPP	Public–Private Partnership
RUDA	Ravi Urban Development Authority
SDG	Sustainable Development Goal
UNFCCC	United Nations Framework Convention on Climate Change
VCM	Voluntary Carbon Market
VCS	Verified Carbon Standard
VVB	Validation and Verification Body

01 Executive Summary

Pakistan is increasingly engaging with international carbon markets as a mechanism to attract climate finance and support low-carbon development. As global carbon market rules evolve and scrutiny around credit integrity increases, there is a growing need to identify mitigation activities in Pakistan that are technically feasible, aligned with the country's emissions profile, and capable of generating credible carbon credits.

This report synthesizes Pakistan-specific sector data, registry evidence, and market pricing signals to identify ten carbon-credit opportunity areas that are currently relevant for project development and potential monetization under 2026 market conditions. The selection of these opportunities reflects several structural factors shaping Pakistan's carbon market landscape: the country's emissions profile is heavily concentrated in methane-intensive and AFOLU sectors; the power sector's decarbonization pathway remains uncertain and influences credit volumes for grid-linked projects; and Pakistan has recently introduced a national authorization framework that may affect revenue outcomes for internationally transferred mitigation outcomes.

Pakistan's official 2021 inventory in its first Biennial Transparency Report[1] shows total emissions of 521.46 $MtCO_2e$, with AFOLU at 46.75% of total emissions. A practical implication for project developers is that methane and land-based interventions are not niche in Pakistan's mitigation profile; they are structurally aligned with the largest emitting sectors and are therefore more likely to remain policy-relevant over time.



[1] Pakistan's 2021 emissions are recorded at 521.46 $MtCO_2e$ in its BTR (2024) submitted to the UNFCCC; NDC 3.0 estimates 2024 emissions at 585.08 $MtCO_2e$.

Figure 1. Emission Profile of Pakistan 2021

As of FY 2024-25, Pakistan's total installed power generation capacity stood at 41,121 MW, of which 38,431 MW (93.46%) falls within the Central Power Purchasing Agency–Guaranteed (CPPA-G) system and 2,690 MW (6.54%) within the K-Electric (KE) network.

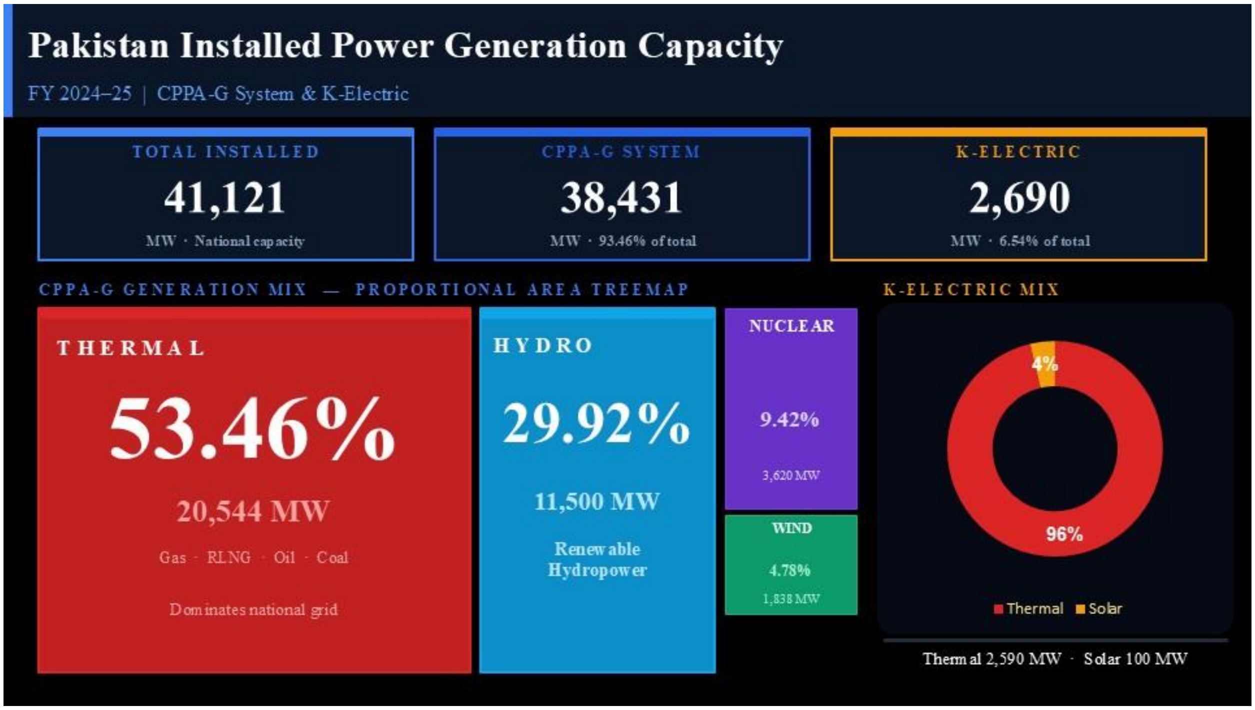


Figure 2. Pakistan's Installed Power Generation Capacity (FY 2024-25)

This capacity composition underscores the continued dominance of thermal generation in Pakistan's power system, while also reflecting a gradual but still comparatively modest expansion of renewable and low-carbon sources. The installed mix has direct implications for grid emission factors and, consequently, for the crediting potential of grid-linked carbon projects.

Market conditions that determine investability in 2026 remain selective. According to *State and Trends of Carbon Pricing 2025*, voluntary carbon credit prices softened slightly in 2024 compared to 2023, but meaningful differentiation by project type has emerged. The average over-the-counter (OTC) voluntary carbon price in 2024 was USD 6.78/tCO_2e, approximately 6% below 2023 levels. Exchange-traded nature-based removal credits closed at around USD 15.50/tCO_2e (April 1, 2025), demonstrating continued resilience relative to avoidance credits. Forward markets show even stronger differentiation. Forward prices for nature-based removals commonly exceeded USD 20/tCO_2e. Credits transacted under Article 6.2 and CORSIA Phase 1 surpassed USD 20/tCO_2e, with Switzerland reporting average purchases above USD 30/tCO_2e for Article 6.2 credits. At the same time, the voluntary market faces structural oversupply pressures. The pool of unretired credits from independent crediting mechanisms increased to nearly 1 billion tCO_2e, two-thirds of which were issued before 2022. Despite this surplus, retirements of nature-based removal credits rose by nearly 25% in 2024, and retirements of clean cooking credits increased by 50% compared to 2023.

For project developers in Pakistan, these market dynamics have direct implications for financial modeling. Rather than relying on a single global average carbon price (for example, USD 6–7 per tCO_2e), project economics should reflect the wide variation in prices across credit categories. Financial assessments therefore need to incorporate price ranges that correspond to project type lower prices for generic renewable energy avoidance credits and substantially higher prices for higher-integrity removals or compliance-eligible credits. In addition, revenue expectations will depend on the contracting approach used, such as spot market sales, forward offtake agreements, or Article 6 authorized transfers, each of which carries different price levels and risk considerations.

A Pakistan-specific constraint, and opportunity, is that the national governance layer is evolving quickly. Publicly circulated "Policy Guidelines for Trading in Carbon Markets" set a fee structure that includes a five percent deduction of credits at source (for NDC-related purposes), a one percent administrative fee on gross revenues, and a corresponding adjustment fee of twelve percent of net revenues for internationally transferred outcomes, with a split between provincial allocation (50%) and a Pakistan Climate Change Fund (50%). Because these parameters move the developer's net revenue in a mechanically large way, they must be modeled explicitly for any Article 6 pathway. Notably, the national climate ministry has publicly stated it issued a first Letter of Intent under Article 6.2/VCM provisions to the 43 acres Mehmood Booti Dumpsite Rehabilitation Project (RUDA), with an indicative volume of ~930,474 tons of verified credits (2026–2040) using UNFCCC-approved methodologies, signaling that authorization workflows are not theoretical.

Against this evidence base, the report identifies ten carbon credit opportunity areas that are relevant for Pakistan in 2026.

Figure 3. Ten Carbon Credit Opportunities for Pakistan (2026)

Scope, evidence base, and how to read this report

As Pakistan begins to engage more actively with international carbon markets, developers and investors face a practical challenge: identifying mitigation activities that can realistically generate credible and monetizable carbon credits under evolving integrity standards and national policy frameworks. While Pakistan has significant mitigation potential across several sectors, not all activities are equally suitable for carbon credit development given constraints related to data availability, methodology requirements, additionality scrutiny, and project economics. This report addresses that gap by identifying carbon credit opportunity categories that appear technically feasible and potentially investable in Pakistan under current market conditions and policy direction.

The analysis is intended primarily for project developers, infrastructure investors, and policy stakeholders who are evaluating carbon-credit project development in Pakistan. These stakeholders are typically concerned with a small set of practical questions: whether a project type aligns with Pakistan's emissions profile and policy priorities, whether credible monitoring, reporting and verification (MRV) systems can be implemented, whether methodologies and precedents exist to support project registration, and whether carbon revenues are likely to remain commercially meaningful after policy deductions and transaction costs.

To answer these questions, the report evaluates opportunity categories against several screening considerations: (i) alignment with Pakistan's sectoral emissions structure and available activity data; (ii) methodological maturity and the presence of precedent projects in Pakistan or comparable markets; (iii) MRV feasibility given Pakistan's data environment;

(iv) additionality risk under the current integrity-focused carbon market environment; and (v) monetization prospects after accounting for national policy deductions and contracting realities.

Pakistan's emissions profile provides an important anchor for this analysis. Official reporting indicates that AFOLU and energy are the largest sources of emissions in the national inventory, while the waste sector represents a smaller but still material share. Pakistan's Third National Communication further indicates that waste-sector emissions are dominated by methane from solid waste disposal and wastewater treatment. At the same time, communication highlights the limited availability of consistent annual waste data across municipalities. This data gap introduces uncertainty for project development, but it also creates opportunities for developers that invest in robust measurement systems and auditable monitoring infrastructure.

The research note draws on (a) Pakistan official climate documents and sector reporting available via the UNFCCC document repository (including Pakistan's BTR 2024, and national communications hosted through third-party public repositories that mirror official submissions); (b) energy-sector statistics captured in NEPRA's State of Industry reporting as reproduced in publicly available excerpts; (c) national policy fee parameters as shown in publicly available policy guideline copies and third-party summaries that quote the fee schedule; (d) registry evidence from the UNFCCC CDM database and from the Global Carbon Council project portal; (e) Verra and Gold Standard rule documents and notices that define fees and audit/assurance requirements; and (f) VCM market analytics (Ecosystem Marketplace, Sylvera, BeZero) that are widely referenced by market participants.

In line with the problem outlined above, this research note highlights carbon credit opportunity areas that may be relevant for investors and project developers exploring projects in Pakistan. Each opportunity class is therefore evaluated from first principles with Pakistan-specific numeric anchors: power generation mix and proxy grid emission factors for grid-linked projects; solid waste mass and treatment assumptions for methane projects; agricultural and livestock population indicators for biogas aggregation; and recent Pakistan infrastructure announcements for EV and storage categories. Pakistan's 2025 updated NDCs are treated as policy context rather than as forecasts; in particular, the NDCs signal where government attention and international finance may cluster, but they do not themselves resolve additionality or marketability. Pakistan's updated NDC (latest communication cycle) reaffirms the country's intention to pursue both domestic mitigation and international cooperation under Article 6 of the Paris Agreement. The NDC maintains a significant portion of mitigation ambition as conditional upon international climate finance, technology transfer, and capacity building, while explicitly recognizing carbon markets and internationally transferred mitigation outcomes (ITMOs) as potential channels for mobilizing climate finance. However, participation in Article 6 mechanisms remains subject to national authorization procedures, corresponding adjustment requirements, and robust monitoring, reporting, and verification (MRV) systems. Accordingly, while the updated NDC strengthens the policy rationale for engaging in carbon markets, it does not eliminate project-level approval, accounting, and governance hurdles that developers must navigate.

02 Pakistan Carbon Market Context in 2026

Pakistan's mitigation policy narrative has become progressively more explicit and quantified over successive NDC cycles. Under NDC 2.0, Pakistan committed to reducing projected 2030 emissions by 50%, comprising 15% unconditional reductions through domestic resources and 35% conditional on international financial support. In its latest NDC 3.0 (2025), Pakistan extends its mitigation horizon to 2035 and sets an indicative voluntary target to reduce projected 2035 emissions of 2,559 MtCO_2e to approximately 1,280 MtCO_2e, a 50% reduction. Of this, 17% is unconditional and 33% is conditional upon adequate, grant-based, new and additional international climate finance, alongside technology transfer and capacity building. The total estimated investment requirement to deliver this ambition is USD 565.7 billion by 2035.

For carbon market participants, NDC 3.0 explicitly reiterates Pakistan's intention to explore and utilize cooperative approaches under Article 6 of the Paris Agreement, while emphasizing environmental integrity, transparency, and avoidance of double counting. This signals a clear policy orientation toward structured engagement with international carbon markets. However, the strengthened conditionality framework and quantified national emissions trajectory also imply that authorization decisions and corresponding adjustment policies are likely to be managed strategically to safeguard national accounting space. For developers, this reinforces the material importance of distinguishing between authorized and non-authorized outcomes under Article 6.2 and emerging Article 6.4 rules.

Importantly, NDC 3.0 confirms that Pakistan's emissions are projected to grow substantially under business-as-usual conditions rising from 405 MtCO_2e in 2015 to 2,559 MtCO_2e by 2035. This structural growth trajectory creates dual incentives for the government: mobilizing carbon finance while retaining sufficient mitigation outcomes to meet its unconditional and conditional targets. As a result, the governance layer surrounding corresponding adjustments, benefit-sharing arrangements, and authorization procedures is likely to tighten rather than loosen over time.

Within the national emissions structure, methane-relevant sectors remain particularly significant. Pakistan's most recent GHG inventory (2024) estimates total emissions at 585.08 MtCO_2e, with AFOLU, energy, and waste continuing to play material roles in the emissions profile. The waste sector alone includes substantial methane emissions from solid waste disposal and wastewater management. In a context where baseline data systems remain uneven across municipalities, developers that invest in robust measurement infrastructure including weighbridge systems, compositional sampling, landfill gas flow metering, and wastewater flow/COD monitoring are better positioned to construct defensible baselines and secure higher-integrity credit issuance.

In the power system, Pakistan's FY 2024–25 generation mix remains heavily fossil-linked (RLNG, gas, coal, and RFO), with nuclear and hydro making up a large non-fossil share. For carbon-credit projects that depend on grid displacement, this mix is a double-edged constraint. It creates large baseline emissions per MWh in the near term, but it also creates regulatory and integrity pressure because renewable energy projects are often screened for "common practice" and "financial additionality" in markets where renewables may already be economically attractive or subsidized. Pakistan's rapid rooftop solar uptake reinforces this additionality pressure.

According to *NEPRA's State of Industry Report 2025*, net-metered rooftop solar capacity continued to grow rapidly. By the first nine months of FY 2024–25, net-metering capacity had reached 4.9 GW, indicating substantial uptake across the country. This build-out reflects both increased consumer adoption and a sharp increase in solar PV module imports, which in FY 2024 alone reached approximately 16 GW (solar panel imports by capacity. In this context, cumulative net-metered rooftop solar capacity reported by other sources including roughly 2.8 GW as of 31 March 2025 represents a more conservative subset of total rooftop installations, given that provisional nine-month figures in the NEPRA report show capacity nearing 4.9 GW by late FY 2024–25. The exposure to behind-the-meter and off-grid installations implied by large import volumes suggests that a significant share of solar capacity remains outside formal net-metering statistics.

If rooftop solar deployment in Pakistan is expanding rapidly, why has this growth not translated into a comparable increase in solar projects within carbon markets? The explanation lies largely in additionality considerations and market integrity standards. This rapid and largely market-driven surge in rooftop solar deployment means that utility-scale solar is not automatically considered a high-priority carbon-credit opportunity in Pakistan. In carbon markets, projects must demonstrate that emission reductions would not occur without carbon finance. Where solar deployment is already commercially attractive due to falling module prices and high electricity tariffs, it becomes difficult to prove such additionality. As a result, solar projects in Pakistan are more likely to be creditable only when structured around clear barriers or incremental investments, such as grid constraints during daytime peaks, displacement of off-grid diesel generation, integration with energy storage systems, or other configurations that go beyond prevailing commercial deployment trends.

Pakistan's national carbon-market governance layer has immediate financial consequences. Publicly circulated policy guidelines describe an obligatory structure consisting of a five percent deduction of credits at source (toward NDC-related purposes), a one percent administrative fee on gross revenues from credit sales, and a corresponding adjustment fee (CAF) of twelve percent of net revenues for internationally transferred outcomes, with a 50/50 split between the province and a national climate fund. Regardless of how "net revenues" are ultimately operationalized in rules and implementation guidance, these parameters set a floor on policy-related deductions that can be economically significant for developers in low-price credit categories. This is precisely why, in Pakistan, VCM-only and Article 6-authorized/ITMO strategies are not merely claim-label differences; they are distinct project-economics regimes.

The Mehmood Booti dumpsite case illustrates what operationalization looks like. The climate ministry publicly states it issued the first Letter of Intent under Article 6.2/VCM provisions to the Mehmood Booti Dumpsite Rehabilitation Project, including a stated investment of PKR 5 billion (USD 18 million) and an indicative 930,474 tons of verified credits from 2026 to 2040 using UNFCCC-approved methodologies across landfill gas capture, leachate treatment, afforestation, and solar generation. Even if subsequent authorization and issuance steps remain, this is a strong signal that government attention is focused on multi-measure landfill rehabilitation packages that produce measurable methane reductions and co-benefits. It also implies that future high-profile projects may be expected to integrate benefit-sharing and authorization requirements early, rather than treating them as end-stage formalities.

A final contextual anchor is precedent. Pakistan has a deep legacy portfolio under the CDM and a smaller but growing footprint in newer registries. On the CDM side, Pakistan has multiple issued waste-heat recovery projects in cement, with public issuance histories in the UNFCCC CDM database, demonstrating that industrial energy projects have historically been able to pass additionality and MRV scrutiny in Pakistan when well documented. On the AFOLU side, the Delta Blue Carbon project is showcased by Verra as a VCS+CCBS registered mangrove restoration project spanning a very large area in Sindh, establishing both a precedent and a reference point for what “high integrity” looks like under modern scrutiny. On the GCC side, Pakistan wind projects are being registered and verified, some with CORSIA-related labels, which is relevant because compliance adjacency is a major driver of price differentiation.

03 Carbon Credit Price Trends 2023-2026 and Implications for Pakistan

The 2023–2026 pricing environment is increasingly characterized by the fragmentation of the voluntary carbon market into integrity-defined micro-markets rather than a single global carbon price. In practice, different credit categories now trade in distinct price bands depending on perceived environmental integrity, durability of emissions reductions, and methodological robustness. Nature-based removal projects such as mangrove restoration or high-quality afforestation often command higher prices because they are associated with carbon removal and co-benefits such as biodiversity protection. In contrast, avoidance-based credits from categories such as grid-connected renewable energy or conventional biomass projects typically trade at lower prices, partly because buyers increasingly question whether these projects require carbon finance to proceed. As a result, the market has evolved into multiple pricing segments in which project type, methodology credibility, and monitoring robustness significantly influence credit value.

Within this segmented market structure, overall transaction activity also declined in the early part of the period. Public market reporting indicates that 2023 saw a sharp contraction in voluntary carbon market transaction value (reported at approximately $723 million), driven by reduced transactions in historically large categories such as REDD+ and renewable energy, as buyers paused purchases amid integrity controversies and awaited methodology revisions.

A parallel tightening of integrity standards is visible in the Integrity Council for the Voluntary Carbon Market's Core Carbon Principles (CCP) screening outcomes reported via Reuters, where renewable energy credits failed at scale due to additionality concerns. Additionality refers to the requirement that emissions reductions would not have occurred in the absence of carbon finance. Where renewable energy projects are already commercially viable, buyers and standards increasingly question whether carbon credits represent genuine incremental mitigation. As a result, projects perceived as financially non-additional may face price discounts, reduced buyer demand, or exclusion from certain high-integrity labels. For developers in Pakistan, this means that project categories which are relatively straightforward to implement such as generic grid-connected renewable energy may also be the most exposed to integrity-driven price pressure unless they can demonstrate clear barriers, incremental investment requirements, or other evidence that the project depends on carbon revenue.

In 2024, Ecosystem Marketplace, a global voluntary carbon market data platform, reported that average transaction prices remained structurally above pre-2021 levels, around $6.3–$6.4/tCO_2e, while total reported market value fell to $535m as both volume and price declined modestly from early-2020s peaks. This "prices held, liquidity fell" pattern matters because it shifts developer risk from price volatility alone to liquidity and counterparty risk. Developers planning Pakistan projects in 2026 should assume that selling volume is not guaranteed at any price and that the ability to evidence integrity, avoid reputational risk, and offer credible claims framing can be as important as project IRR.

In 2025, Sylvera's, a carbon credit ratings and analytics firm, reported retirement volumes of around 168 million credits, with market value rising and weighted average prices around $6.10 as buyers paid more for higher-integrity supply. Most importantly for project finance, Sylvera reports a large expansion in forward offtake deals announced in 2025 with aggregate deal value in the tens of billions and a very high weighted average price for durable credits (reported around $180), albeit at low annual delivered volumes relative to overall retirements. This suggests a capital markets transition where developers with high-integrity, high-durability products can access forward capital, while low-integrity products remain stuck in commodity-like spot markets. Pakistan's opportunity set is therefore split: most Pakistan near-term opportunities are "abatement" or "avoidance" with mid-to-low prices, while a smaller subset (credible removals in mangroves/ARR, high-integrity methane abatement, potentially high-quality smallholder agroforestry) can, in principle, approach higher bands if designed to satisfy buyer integrity screens.

Quality-linked price differentiation is no longer speculative. **BeZero Carbon, a carbon credit ratings agency, finds** in its analysis of nature-based pricing data that higher-rated credits command a measurable price premium, with an average premium per rating notch and large price spreads across specific sectors. While Pakistan developers should consider such third-party ratings as useful market signals, they should not treat them as determinative. Credit ratings are produced using proprietary methodologies and can vary across rating agencies, while many buyers conduct their own due diligence before purchasing credits. As a result, ratings should be viewed as one indicator of perceived project quality rather than as a guarantee of price outcomes or buyer acceptance.

For developers, the practical implication is that verification alone is no longer sufficient to secure strong market demand. Projects increasingly need to demonstrate clear environmental integrity through conservative baseline assumptions, credible permanence arrangements where relevant, transparent monitoring systems, and documented benefit-sharing with affected communities. In practice, this means investing early in robust monitoring, reporting, and verification (MRV) systems, documenting land tenure and project governance arrangements, and maintaining transparent data records that can withstand scrutiny from auditors, rating agencies, and buyers. This is particularly relevant for Pakistan's largest headline category i.e., mangrove and blue carbon projects, which combine high mitigation potential with heightened scrutiny from both investors and environmental integrity watchdogs.

Because Pakistan-specific spot indices are not publicly standardized, his research note presents indicative category-based price bands informed by the market evidence discussed above. A conservative, evidence-aligned way to express 2026 price expectations is to model (i) low-integrity or weak-additionality avoidance categories in the low single digits; (ii) mid-integrity methane and distributed energy access categories in high single digits to low teens; and (iii) high-integrity nature-based and removals categories in the low-to-mid tens for spot, with potentially higher values under high-quality labeling, co-benefit certification, or compliance adjacency. Where Pakistan policy deductions apply (credit reservation, administrative fees, and CAF), the developer's net-of-policy price is lower than the buyer's headline price, and this wedge must be explicitly modeled.

A useful investor-facing summary is shown in the following table. These are scenario bands meant for screening and are consistent with the direction of reported market averages and integrity-linked premiums described above, and must not be taken as guaranteed prices

Table 1. Carbon Credit Price Bands and Key Valuation Drivers

Credit category (integrity-adjusted)	Price band to underwrite for Pakistan screening (USD/tCO_2e)	Main determinants of being in the upper vs lower end
Generic renewable energy avoidance (grid-linked)	1–5	Additionality strength; vintage; CCP/label eligibility; curtailment and baseline rigor; buyer reputational risk sensitivity
Industrial energy efficiency and waste heat (cement, textiles)	4–10	Metering completeness; clear incremental capex; verifiable baseline; counterparty risk; co-benefits
Landfill methane, wastewater methane abatement	6–15	Baseline defensibility; continuous metering; destruction efficiency; host authorization strategy; local permits; third-party ratings
Household/community programs (clean water systems, cookstoves, biogas)	6–15	Sampling design; leakage/use monitoring; non-renewable biomass fraction; safeguarding; programmatic governance
High-integrity ARR/agroforestry/blue carbon removals	12–30 (spot), higher under premium structures	Permanence and leakage controls; MRV quality (remote sensing + field); tenure clarity; benefit sharing; buffer contributions; rating outcomes
Compliance-adjacent / authorized outcomes (where eligible)	Case-specific; generally premium to non-authorized	Authorization, corresponding adjustment, eligibility (e.g., CORSIA labels), contractual structure, and host-country accounting reliability

04

Active Carbon Projects in Pakistan

Pakistan's current project landscape across registries is uneven, and that unevenness is itself informative. It indicates which categories have Pakistan precedent and where developers face a steeper first-mover burden. The table below lists representative Pakistan projects by registry and status using publicly accessible registry or registry-adjacent sources. The intention is not to be exhaustive but to show that several of the ten priority categories already have Pakistan precedent, which reduces methodological and execution risk compared to categories with no local track record.

Table 2. Carbon Credit Projects in Pakistan

Project name	Registry / program	Pakistan location	Type	Status / key public indicator
Delta Blue Carbon – 1	Verra (VCS + CCBS)	Sindh (Indus Delta)	Mangrove restoration / ARR (tidal wetlands)	Registered; large-scale restoration footprint reported publicly
Delta Blue Carbon 2	Verra (project pipeline)	Sindh (Sujawal/Badin)	Mangrove/blue-carbon restoration	Under validation (pipeline)
Safe Drinking Water Programme in Punjab	Verra (project pipeline)	Punjab	Energy demand (replacing water boiling using biomass/fossil)	Registered
Safe Drinking Water Program in Sindh	Verra (project pipeline)	Sindh	Energy demand	Registered
Zorlu Enerji Wind Project	UNFCCC CDM (and Gold Standard CER)	Sindh (Thatta/Jhimpir area)	Wind power	CDM: issued CERs reported; also issued GS CERs reported (historic)
Waste Heat Recovery at Bestway Cement (15 MW)	UNFCCC CDM	Chakwal	Industrial waste heat recovery	CDM issuance recorded for monitoring period and issued status visible on UNFCCC page
Fauji Cement WHR	UNFCCC CDM	Pakistan	Industrial waste heat recovery	CDM issuance recorded and issued status visible on UNFCCC page
Wind Power Project in	GCC	Sindh (Jamshoro)	Wind power	Verification outcome published; CORSIA-related

Jamshoro (Master Green)				labeling referenced in verifier outcome
Hawa Energy Wind Farm Project	GCC	Sindh (Jhimpir/Thatta)	Wind power	Registered; GCC announcement frames it as first Pakistan GCC project
Mehmood Booti Dumpsite Rehabilitation Project	National authorization pathway (LoI)	Lahore	Landfill gas + leachate + afforestation + solar package	First LoI under Article 6.2/VCM provisions reported by climate ministry; indicative credits 2026–2040

05

Carbon Credit Opportunities in Pakistan (2026)

Against the market trends and the context discussed above, several mitigation activities emerge as potentially relevant for carbon credit development in Pakistan. Based on sectoral data, market analytics, and observable project precedents, ten opportunity areas are outlined below. These opportunity areas were identified through a review of Pakistan's emissions profile, existing carbon project activity across major registries, and recent developments in voluntary and compliance carbon markets. Particular attention was given to sectors where established methodologies exist, monitoring, reporting, and verification (MRV) systems can be implemented under Pakistan's data conditions, and where project outcomes are more likely to withstand increasing scrutiny from buyers and standards. The selection also considers factors such as additionality, baseline credibility, MRV feasibility, implementation barriers, scalability, and alignment with emerging integrity expectations in carbon markets. Each opportunity is therefore presented as a project category accompanied by implementation considerations related to MRV design, sector context, and policy conditions that may influence project development in Pakistan.

The ten opportunity classes for Pakistan in 2026 are identified based on expected issuance feasibility, integrity resilience, and monetization realism. The identification of these opportunities is not a statement about absolute mitigation potential, but about bankable near-term projects that investors and developers can execute with credible MRV and defendable additionality. Each class is presented as a distinct investment thesis with MRV and policy notes to guide both project structuring and developer diligence.

I: Landfill Methane Capture, Legacy Dumpsite Rehabilitation, and Integrated Waste-to-value Packages

Pakistan's waste sector represents a meaningful component of the country's greenhouse gas emissions profile. In official reporting, waste accounts for approximately 6.22% of national emissions, driven largely by methane released from solid waste disposal sites and wastewater systems. Pakistan's Third National Communication estimates waste-sector emissions at 32.44 $MtCO_2e$ and identifies methane from solid waste disposal as a primary contributor. Methane is particularly relevant in carbon credit projects because it has a significantly higher global warming potential than carbon dioxide over a 100-year time horizon. Carbon projects in this category therefore generate credits by capturing methane that would otherwise escape into the atmosphere, typically through landfill gas collection systems or controlled flaring, and converting the avoided emissions into measurable and verifiable emission reductions.

The communication also reports a national solid waste generation estimate of around 18.8 million tons (for the inventory year), calculated at approximately 0.65 kg per capita per day, while noting substantial uncertainty due to the absence of consistent annual municipal solid waste data. This combination of high methane emissions and limited baseline datasets creates both a challenge and an opportunity for carbon project development. Developers that establish robust monitoring systems such as waste flow measurement, landfill gas capture infrastructure, and transparent data management can transform improved measurement and methane abatement into verifiable carbon credits.

Pakistan's urban waste volumes are large enough to support scale economics. Government-linked estimates cited in public trade guidance put Pakistan's solid waste generation around 49.6 million tons/year, with Karachi alone generating over 16,500 tons/day and Lahore ~7,690 tons/day (though such figures should be treated as indicative because they are not presented as an audited national dataset). Even if one uses conservative waste flows, the investable reality is that major city dumpsites and landfills have both methane abatement potential and strong local co-benefits (odor reduction, leachate control, fire risk mitigation, and land reuse), which supports "impact + mitigation" narratives that are increasingly demanded by credit buyers.

The strongest Pakistan-specific evidence that landfill packages are now central to the national carbon market is the Mehmood Booti project. The climate ministry publicly reports that it issued the first Letter of Intent under Article 6.2/VCM provisions to the Mehmood Booti Dumpsite Rehabilitation Project (developer RUDA), describing a PKR 5 billion investment and an estimated 930,474 tons of verified credits between 2026 and 2040 using UNFCCC-approved methodologies spanning landfill gas, leachate, afforestation, and solar. This is a structural signal: multi-measure landfill rehabilitation packages can be framed as both mitigation projects and urban infrastructure upgrades, which helps them access government attention and potentially structured finance. It is also a warning: these projects are likely to be pulled into authorization and benefit-sharing frameworks early, and developers should not assume the VCM is a policy-free zone.

The number of carbon credits issued in landfill methane projects depends directly on measured and verifiable methane reductions, making monitoring, reporting, and verification (MRV) systems a central component of project integrity. While MRV requirements for high-integrity landfill methane projects are straightforward in principle, they can become failure-prone in practice. A robust system requires measured methane flow, methane concentration, destruction efficiency, downtime logging, and evidence that the gas would not otherwise have been captured or oxidized at comparable levels in the baseline. In Pakistan, additional MRV complexity arises because many dumpsites are legacy open dumps with no historical metering. That raises baseline disputes unless the project documents historical site conditions, waste-in-place estimates, and methane generation modeling assumptions transparently and conservatively. In the current integrity environment, projects that rely on weakly evidenced baseline models without measured operational data face both issuance risk and price discounts.

Projects in this category are most likely to be developed by entities that control landfill sites or possess the technical and financial capacity to implement waste infrastructure upgrades. In Pakistan's context, this typically includes municipal authorities responsible for landfill management, public–private partnership (PPP) developers involved in waste infrastructure projects, specialized waste management companies, and infrastructure investors working with city governments.

II: Mangrove and Blue Carbon Restoration in Sindh and the Indus Delta

Pakistan's most globally visible carbon-credit category is blue carbon, specifically mangrove restoration in the Indus Delta. This category's investability is driven by three Pakistan-specific facts: the country has globally significant arid-climate mangrove ecosystems; land degradation and sea intrusion create restoration demand with adaptation co-benefits; and Pakistan already has a flagship Verra-registered project that establishes a precedent for methodology application at scale. In carbon market terms, mangrove restoration projects generate credits by increasing carbon storage in both biomass and coastal sediments while avoiding emissions associated with degraded coastal ecosystems. As mangrove forests regenerate, they capture atmospheric carbon dioxide through photosynthesis and store it in tree biomass, root systems, and underlying soils creating measurable carbon sequestration that can be quantified and verified under established blue carbon methodologies. Verra presents Delta Blue Carbon Phase 1 as registered under both VCS and CCBS, spanning a reported ~350,000 hectares in Sindh's Indus Delta region and integrating mitigation and adaptation outcomes alongside community participation and biodiversity objectives. A project of this scale inevitably shapes both buyer expectations and regulatory expectations for future blue carbon initiatives in Pakistan.

Pakistan-specific ecosystem scale indicators underscore why this category is not a boutique. Public reporting referencing the Sindh Forest Department indicates large mangrove land extents in Sindh's Indus delta region and large restoration interventions over recent years, although reported figures vary depending on the definition of mangrove land, visible mangroves, and restoration methods. This variability has practical implications for project development because area claims must align with remote sensing evidence, field plots, and legal/tenure boundaries under modern standards. Investors should treat tenure clarity and enforceable management rights as a condition precedent for blue-carbon bankability, not as a post-registration detail.

From a market perspective, mangroves can access higher price bands than commodity avoidance credits when designed and communicated as high-integrity removals with credible permanence controls and transparent community benefit sharing. Third-party analytics indicate spot prices for high-quality ARR credits rose materially through 2025 in some parts of the market, and quality-linked premiums are observable in nature-based credits. For Pakistan developers, this suggests that mangrove projects should be structured with a deliberate integrity strategy: conservative baselines, transparent leakage management, buffer contributions where required, and defensible social safeguarding.

Potential projects in this category can be led by institutions with jurisdiction over coastal ecosystems or experience in large-scale conservation programs. In Pakistan, this typically includes provincial forest and coastal management departments, conservation organizations and NGOs involved in ecosystem restoration, public–private partnerships supporting coastal resilience initiatives, and specialized carbon project developers working with government agencies and local communities. Large-scale blue carbon projects often require coordination between government authorities responsible for land tenure and ecosystem management and technical partners capable of designing carbon accounting and MRV systems.

III: Utility-scale Solar and Distributed Solar in "Selective" Additionality Configurations

Solar power projects generate carbon credits by producing electricity from renewable sources that displace grid electricity generated from higher-emission fossil fuels. The resulting emission reductions are calculated based on the difference between the emissions associated with grid electricity and the near-zero operational emissions of solar power generation.

Pakistan has experienced rapid solar adoption, particularly through rooftop net metering. As noted above, NEPRA-reported net-metering capacity reached 2,498 MW by June 2024 and rose further to around 2,813 MW by March 2025 according to government reporting. These figures reflect strong growth in decentralized solar deployment and represent a positive development for Pakistan's energy security and electricity cost structure. From a carbon market perspective, however, widespread market-driven adoption can create additionality concerns. Where solar deployment is already economically attractive due to falling technology costs and high electricity tariffs, it becomes more difficult to demonstrate that a project depends on carbon finance to proceed. Integrity bodies have therefore increasingly scrutinized renewable energy credits where projects appear commercially viable without carbon revenue.

This does not imply that renewable energy projects must be overlooked entirely when thinking about carbon credits. To adapt, Solar projects in Pakistan must be carefully aligned with carbon project guidelines from Day 1 of their commercial decisions to remain creditable. The strongest configurations are those where the solar project, as a carbon project, demonstrably overcomes a financing barrier, a grid constraint, or displaces a high-emission off-grid diesel baseline that would otherwise persist. The weakest configurations are those that look like ordinary commercial solar responding to high electricity tariffs and low panel prices, because those can fail investment additionality tests under modern scrutiny.

A further structural shift affecting additionality is the transition from the previous net-metering framework to a formal net billing regime under the NEPRA (Prosumer) Regulations, 2026. Regulation 14 introduces a billing mechanism whereby electricity exported by the prosumer is compensated at the national average energy purchase price, while imported electricity is billed at the applicable retail tariff (Regulation 14(1)(a)–(b)). This replaces the earlier one-to-one netting structure and materially alters the revenue economics of rooftop solar systems. In addition, the regulations cap distributed generation capacity at the sanctioned load of the applicant (Regulation 3(2)) and prohibit interconnection where transformer loading has reached 80% of rated capacity (Regulation 3(5)). Agreements are limited to five-year terms, renewable upon mutual consent (Regulation 7). Collectively, these provisions introduce greater tariff, grid, and policy uncertainty relative to the earlier regime. For carbon credit developers, this shift cuts both ways: it weakens the "automatic commercial viability" argument that undermines solar additionality, yet it also reinforces the need for careful baseline and revenue modeling, particularly where export compensation is decoupled from retail tariff levels.

A related nuance is baseline emission factor choice. Pakistan-specific grid emission factors vary substantially across sources and years, and the choice of method (operating margin versus combined margin, ex ante versus ex post) changes credit volumes materially. A UNFCCC-hosted series used in a NAMA context reports a grid emission factor declining from ~0.67 tCO_2e/MWh in 2015 to ~0.40-0.43 in 2022–2025. This suggests a plausibly declining baseline over time, which reduces future credit volumes per MWh and therefore reduces bankability if a project is underwritten on a static EF. Developers should therefore be wary of EF as a sensitivity driver and be up to date with approved EF numbers in the given year, to prevent over estimating number of credits that can be generated from their project.

Actors most likely to implement projects in this category include independent power producers, distributed solar developers, commercial and industrial energy service providers, and infrastructure investors participating in grid-connected renewable energy projects. In some cases, large commercial or industrial electricity consumers installing solar capacity for captive use may also participate through programmatic crediting structures where electricity displacement can be reliably measured and verified.

IV: Battery Energy Storage Systems (BESS) as an Emerging, Policy-linked Mitigation

Battery Energy Storage Systems (BESS) are grid-scale or industrial battery installations that store electricity when supply is abundant and release it when demand is high. In power systems with growing renewable energy capacity, BESS can help stabilize the grid by storing surplus electricity from solar or wind projects and supplying it during periods of high demand or low renewable generation. This capability allows electricity systems to integrate higher shares of renewable energy while reducing reliance on fossil fuel–based peaking plants.

Although BESS is not yet a mainstream carbon-credit category in Pakistan in the same way as landfill methane or mangrove restoration, it is emerging as an infrastructure priority in the country's power sector. Pakistan-specific policy signals include a reported Power Division decision to establish a committee to develop a national BESS deployment roadmap, including siting and procurement options such as public–private partnerships and coordination with development partners.

From a carbon market perspective, the potential carbon value of BESS projects arises from their ability to enable greater integration of renewable electricity and reduce reliance on fossil fuel–based generation during peak demand periods. By storing excess renewable power that might otherwise be curtailed and displacing peaker plants or inefficient thermal generation, BESS can indirectly reduce greenhouse gas emissions within the power system. If these impacts can be quantified through robust baselines and operational data such as charging sources, discharge patterns, and grid emission factors, BESS projects may become eligible under emerging carbon credit methodologies.

MRV complexity in BESS is high because the emission impact is indirect: storage shifts energy across time, affects dispatch, and interacts with marginal generation. This makes it vulnerable to over-crediting if baselines are simplistic. Investors should therefore treat BESS credits as speculative unless (i) the methodology is explicit about dispatch impacts, (ii) grid operator data is available, and (iii) conservative assumptions are used. In the near term, the most defensible BESS-credit thesis is not “storage is green,” but “storage reduces fossil peaker dispatch or increases renewable utilization at measurable margins,” evidenced with grid data and conservative accounting.

Implementation in this category would likely involve entities active in the electricity and infrastructure sectors. Potential developers include electric utilities, independent power producers, energy infrastructure investors, and technology providers participating in grid modernization initiatives. Public–private partnership concessionaires and industrial energy users installing large-scale storage systems may also play a role, particularly where storage is deployed alongside renewable energy generation or within microgrid systems.

V: Livestock Biogas Aggregation and Manure Management Programs

Pakistan’s emissions profile and agricultural structure make livestock methane an unusually large theoretical mitigation pool, but the category is only investable when aggregation and MRV are designed around Pakistan’s institutional reality. Government reporting cited via the Economic Survey indicates very large livestock populations: cattle around 59.7 million and buffalo around 47.7 million by July-March 2025, with goats around 89.4 million and sheep around 33.1 million. This scale suggests that even programmatic interventions with low per-unit abatement can reach meaningful volumes if aggregation is executed.

The core design challenge is that Pakistan’s livestock sector is dominated by smallholders with heterogeneous practices, which makes baseline definition and monitoring expensive if approached at the unit level. The investable approach is therefore programmatic: standardized digester packages, centralized monitoring of biogas use or displacement, statistically defensible sampling where allowed, and digital MRV that reduces per-beneficiary audit cost. Integrity risk for household and community programs is high in a post-2023 environment if usage is not evidenced; “installed” does not mean “used.” Program developers therefore need auditable evidence of sustained operation: gas flow measurements, appliance use data, maintenance logs, and independent checks. The payoff is that methane projects (when robust) can command better demand than generic renewables because they align with global methane reduction priorities and because measured methane abatement has clearer incrementality than some renewable categories.

Projects in this category can be developed through programmatic structures led by organizations capable of aggregating large numbers of smallholder livestock operations. In Pakistan’s context, this typically includes agricultural cooperatives, livestock sector NGOs, and development organizations experienced in household-level clean energy or biogas deployment. Carbon project developers working in partnership with provincial livestock departments, rural development programs, and microfinance institutions may also be well positioned to implement large-scale livestock biogas aggregation programs and manage monitoring and verification requirements across dispersed beneficiaries.

VI: Brick Kiln Modernization, Zigzag Conversion, and Eligible Black-carbon-aligned Interventions

Pakistan’s brick kiln sector is both politically and environmentally significant and is under the focus of Government of Pakistan for good reason. In carbon market terms, projects in this sector generate credits by reducing fuel consumption and associated greenhouse gas emissions during brick production. Technologies such as zigzag kiln conversion improve combustion efficiency, allowing kilns to produce the same output using less coal or other fuels. The resulting reduction in fossil fuel use lowers carbon dioxide emissions, creating measurable emission reductions that can be quantified under applicable carbon crediting methodologies. Public reporting indicates large kiln counts and a strong push toward zigzag technology adoption, with a Pakistan provincial crackdown reporting inspections of around 11,000 kilns in Punjab and claims that 95% were converted to zigzag technology, alongside demolitions (1,191 kilns) and seals (1,335 kilns) for non-compliance. Separate official communication in the federal capital reports 49 of 63 traditional kilns converted to zigzag technology, with the climate ministry stating that conversion helps mitigate air pollution and emissions. These figures imply that a large share of the conversion process may become a regulatory requirement, which can reduce additionality if projects merely comply with mandates. The investable niche therefore shifts from basic zigzag conversion toward incremental interventions that remain above the regulatory baseline, such as fuel switching away from high-emission fuels, advanced combustion control with verifiable performance, or cluster-level modernization where finance barriers persist.

From a carbon-crediting standpoint, brick kilns are complex because some benefits such as reductions in black carbon and particulate emissions are not always fully recognized as CO_2e reductions under mainstream carbon crediting frameworks. However, several eligible emission reduction pathways remain available. Zigzag conversion can reduce fuel consumption per brick by improving combustion efficiency, while fuel switching away from high-emission fuels and improved combustion management can further reduce carbon dioxide emissions from kiln operations. These interventions create measurable emission reductions when fuel consumption and brick production output are properly metered and audited. On-ground economic barriers remain visible: reporting from Rawalpindi indicates high zigzag conversion costs (on the order of PKR 2.5–3 million per kiln) and closures, which supports the case that targeted finance mechanisms could drive incremental adoption in lagging districts. The investor takeaway is that brick kiln projects require careful baseline definition to avoid "regulatory surplus" failures and a credible plan to evidence fuel and production changes across different intervention types.

Sector-wide modernization programs involving kiln owners, industry associations, and specialized project developers are required to develop projects in this category. In Pakistan's context, brick kiln associations, industrial cluster programs, and carbon project developers working with provincial environmental departments are well positioned to coordinate technology upgrades across multiple kilns. Development agencies and climate finance programs supporting cleaner brick production may also act as program aggregators, particularly where financing and technical assistance are required for smaller kiln operators.

VII: Electric Bus Fleets and Clean Transport Programs with Verifiable Route and Energy Data

Large-scale electric mobility is now a live policy and procurement topic in Pakistan, which creates a near-term pipeline of potentially creditable interventions. In carbon market terms, electric bus projects generate emission reductions by replacing diesel-powered public transport with battery electric vehicles powered by electricity. The carbon value arises from the avoided emissions associated with diesel combustion in conventional buses, provided that fleet operations, electricity consumption, and route data are monitored to quantify the net reduction in greenhouse gas emissions.

Public reporting from Sindh indicates a cabinet-approved plan to add 8,000 electric buses to Karachi's public transport system over four years, with staged deployment and a baseline of 50 already operational buses. Pakistan's capital also received a large batch of electric buses (146 of 160 reported as arrived) for feeder routes, and Punjab announced plans for large deployments across major cities. A PPP frame is explicitly visible: the Government of Sindh PPP Unit describes a "People's Green Transport Project" envisaging 500 electric buses with charging infrastructure and intelligent transport systems under a DBFMOT model, at the investor solicitation stage. These signals matter because creditable EV programs require stable fleet ownership, rigorous operational data, and credible counterfactuals about what would have operated otherwise.

The MRV challenge is that transport baselines are notoriously sensitive to assumptions about displaced vehicles, fuel economy, occupancy, and rebound. Pakistan developers should therefore prioritize contexts where baseline is clean: replacing a specific diesel bus fleet with known fuel records; using route-level GPS and ticketing data; and measuring charging energy with calibrated meters. The category's investability improves further when fleets are integrated with renewable electricity supply or storage strategies, because that reduces grid-related carbon intensity uncertainty. Policy-wise, EV fleets can also be aligned with NDC ambitions; Pakistan's 2025 NDC update targets a large EV share i.e., 30% by 2030, which supports narrative alignment but does not eliminate additionality assessment.

Implementation in this category can be led by entities responsible for public transport fleet procurement and operations. In Pakistan's context, this includes provincial and city transport authorities, public–private partnership concessionaires managing bus fleets, urban mobility operators contracted under DBFMOT or similar PPP models, and infrastructure developers responsible for charging systems and fleet management platforms. Carbon project developers may participate as technical partners supporting program design, emissions accounting, and monitoring systems linked to fleet operations.

VIII: Smallholder Agroforestry and ARR on Degraded Farmland with Credible Tenure and MRV Architecture

Pakistan's climate planning emphasizes nature-based solutions, and the 2025 NDC update references large-scale tree and landscape initiatives as part of its strategy. From a carbon-market standpoint, the investability of smallholder agroforestry projects depends not only on the number of trees planted or the theoretical mitigation potential, but also on institutional and implementation factors such as clear land tenure, free, prior and informed consent (FPIC) of participating communities, leakage management, and robust monitoring, reporting, and verification (MRV) systems. These factors determine whether emission removals can be credibly measured and sustained over time.

Pakistan already has precedent for large-scale nature-based carbon initiatives in coastal ecosystems, particularly blue carbon projects in the Indus Delta. Smallholder agroforestry, however, represents a different risk profile. Such projects are geographically dispersed, involve numerous landholders, and require continuous monitoring to verify tree survival and carbon sequestration. Investors are therefore more likely to support this category where projects demonstrate enforceable land-use rights, clear agreements with participating farmers, credible mechanisms to ensure long-term tree survival, and defensible leakage management, for example by integrating livelihood benefits rather than restricting land use without compensation.

This category can benefit from advances in remote sensing and digital MRV that bring down per-hectare monitoring costs. NASA's GEDI lidar-based products and other satellite approaches illustrate the direction of biomass monitoring technology, though project-level application still requires ground plots, species-specific allometry, and uncertainty management to meet methodology requirements. For Pakistan, the pragmatic approach is hybrid MRV: satellite-derived stratification and change detection, combined with statistically robust field plots and local community monitoring with digital traceability.

Development of projects in this category typically requires organizations capable of coordinating large numbers of smallholder participants and managing long-term monitoring obligations. In Pakistan, this role may be performed by agricultural NGOs, rural development programs, carbon project developers specializing in nature-based solutions, and agribusiness or commodity companies working with farmer networks. Partnerships with provincial forestry and agriculture departments, local cooperatives, and community organizations are often necessary to establish land tenure clarity, farmer participation agreements, and long-term project governance. Case study of an ARR project implemented by Resources Future is briefly explained below.

Case Study: SAVAK - ARR Project in Sindh (Mirpurkhas District)

Project Developer: Resources Future
Location: Mirpurkhas District, Sindh, Pakistan
Project Type: Afforestation, Reforestation and Revegetation (ARR)
Website: www.savak.resourcesfuture.com

Resources Future is developing an ARR carbon project in Mirpurkhas District, Sindh, based on the establishment of Mango and Chico orchard systems on agricultural land. The project introduces perennial tree-based land use in areas currently dominated by short-cycle cropping systems. with the objective of enhancing soil carbon, improving long-term land productivity, and generating verified carbon removal credits for the voluntary carbon market. In this project, the project developer will provide plantation (Mango and Chico saplings) and agronomic support to the participating farmers.

Implementation follows a phased approach beginning with a **300-acre pilot phase**, designed to validate plantation design, monitoring systems, and operational workflows before broader expansion. A core feature of the project is the integration of digital monitoring and spatial analysis. Land parcels are screened using GIS-based suitability assessments and satellite imagery analysis to confirm land-use history and eligibility for afforestation methodologies. Remote sensing indicators and field verification are used to track vegetation growth, canopy development, and long-term carbon sequestration potential.

The project also integrates social safeguards through a structured Free, Prior and Informed Consent (FPIC) process with participating landowners. Farmers voluntarily enroll land parcels and retain ownership of agricultural outputs such as fruit harvests, while Resources Future retains ownership of the carbon credits generated by the project. This pilot illustrates how ARR projects on agricultural land can combine carbon removal with agricultural co-benefits while maintaining traceable monitoring and transparent project implementation.

IX: Biochar Production from Agricultural Residues as a Carbon Removal Pathway

Biochar projects represent an emerging carbon removal category that converts agricultural residues into a stable carbon-rich material through controlled pyrolysis. The carbon value arises from the long-term sequestration of carbon that would otherwise return to the atmosphere through decomposition or open burning of biomass residues. During pyrolysis, biomass such as crop residues is heated in low-oxygen conditions, producing biochar that can remain stable in soils for decades or centuries. Carbon credit methodologies treat this stabilization as a form of durable carbon removal because a portion of the original biomass carbon is converted into a long-lived solid form.

Pakistan has substantial agricultural residue availability that could support this category as this hasn't been applied so far. Crop residues from rice, wheat, cotton, and sugarcane are widely produced across Punjab and Sindh, and these residues are frequently burned or left to decompose in fields, contributing to local air pollution and greenhouse gas emissions. Biochar production offers an alternative pathway in which residues are processed into a soil amendment that can improve soil structure, water retention, and nutrient availability while storing carbon in a stable form. From a carbon market perspective, the emission reduction or removal is quantified based on the amount of biomass carbon converted into biochar and the estimated permanence of that carbon once applied to soil.

The investability of biochar projects depends on several practical factors, including feedstock aggregation, consistent biomass supply, and reliable monitoring of production volumes and biochar application. Carbon accounting frameworks typically require measurement of biomass inputs, documentation of pyrolysis conditions, and verification of biochar stability characteristics. Projects also need credible supply chains linking residue sources to processing facilities and agricultural end users. Where these conditions are met, biochar projects have attracted increasing attention in voluntary carbon markets because they combine durable carbon removal with agricultural co-benefits such as soil improvement and reduced open burning of crop residues.

Biochar initiatives in Pakistan can be implemented by organizations capable of aggregating agricultural residues and managing biomass processing infrastructure. This includes agribusiness companies, agricultural cooperatives, waste-to-value technology providers, and carbon project developers specializing in carbon removal pathways. Partnerships with farmer networks, agricultural extension services, and research institutions may also play a role in establishing feedstock supply chains and monitoring biochar application in agricultural soils.

Case Study: Varaha Earth and the Google Biochar Offtake Agreement (India)

In January 2025, Varaha Earth, a New Delhi-based climate technology company concluded what has been reported as the world's largest carbon dioxide removal offtake agreement for industrial biochar, selling 100,000 credits to Google.

The project, located in Gujarat, converts Prosopis Juliflora (an invasive plant species) and agricultural residues into biochar through pyrolysis. The resulting biochar is distributed back to smallholder farmers as a soil amendment, where the carbon remains stable for decades to centuries. Credits are validated through Puro.Earth, with delivery to Google scheduled by 2030.

On MRV, Varaha uses remote sensing combined with a mobile application capturing geo-tagged, timestamped images at each project stage demonstrating that rigorous monitoring is achievable even in distributed smallholder settings.

Several elements of this project are directly relevant to Pakistan. The feedstock model aggregating residues through smallholder networks mirrors what would be needed in Punjab and Sindh, where crop residue burning is widespread. More broadly, the Google deal confirms that the voluntary carbon market will pay for biochar removal when the project structure is credible and MRV is robust. For Pakistani developers, it offers both a structural template and proof of market demand.

X: Alternate Wetting and Drying (AWD) in Rice Cultivation

Alternate Wetting and Drying (AWD) is a water management practice used in rice cultivation that periodically allows paddy fields to dry instead of maintaining continuous flooding throughout the growing season. In conventional flooded rice systems, anaerobic soil conditions lead to methane production as organic matter decomposes in oxygen-poor environments. AWD reduces methane emissions by introducing intermittent aeration of the soil, which suppresses methane-forming microbial activity. The carbon value of AWD projects therefore arises from the reduction of methane emissions relative to continuously flooded rice cultivation systems.

Rice production represents a meaningful source of methane emissions globally and in South Asia, making improved water management practices a recognized mitigation pathway. AWD projects typically quantify emission reductions by comparing methane emissions under AWD practices with baseline emissions from continuously flooded fields. Monitoring requirements often include verification of irrigation practices, water level monitoring, farmer participation records, and sampling-based measurement approaches consistent with applicable methodologies.

A recent project implementation illustrates the emerging potential of rice methane mitigation in Pakistan. In December 2025, Gold Standard issued **46,714 carbon credits** under its Rice Alternative Wetting and Drying (AWD) methodology, the first issuance of rice methane reduction credits under the Gold Standard for Global Goals registry. The credits were generated through a project in Pakistan developed by NetZeroAg in collaboration with approximately **2,000 smallholder farmers**. The project applied the AWD irrigation technique, which periodically drains rice paddies to disrupt anaerobic soil conditions that normally produce methane during continuous flooding. By introducing intermittent drying periods, the project significantly reduced methane emissions from rice cultivation while maintaining agricultural productivity. The initiative also demonstrates the feasibility of programmatic agricultural mitigation projects, combining farmer training, irrigation management changes, and structured monitoring systems to produce verifiable emission reductions. Further issuances are expected as the project expands to additional farmers, highlighting the scalability of AWD-based mitigation approaches in rice-producing regions.

From an investment perspective, AWD projects require programmatic implementation because rice cultivation is typically conducted by dispersed smallholder farmers. Successful project design therefore depends on farmer aggregation mechanisms, standardized training on AWD practices, and monitoring systems capable of verifying irrigation patterns across large numbers of fields. Where these systems are in place, AWD projects can generate measurable methane reductions while also delivering agronomic benefits such as reduced water use and improved resilience of rice production systems. Hence, AWD programs can potentially be implemented by organizations capable of coordinating large numbers of rice farmers and managing agricultural extension activities. In Pakistan, potential implementers include agricultural NGOs, rural development programs, agribusiness companies working with rice supply chains, and carbon project developers experienced in programmatic agricultural mitigation projects. Collaboration with provincial agriculture departments, irrigation authorities, and farmer cooperatives may also be necessary to support farmer training, water management monitoring, and long-term program governance.

06

Carbon Project Registration, MRV, and Revenue Mechanics

Across all opportunity types, the practical determinants of bankability are the architecture of the monitoring, reporting, and verification (MRV) system and the time and cost required to reach credit issuance. In carbon markets, the number of credits issued is determined by the volume of emission reductions or removals that can be credibly demonstrated through documented evidence and independent verification. Projects that cannot substantiate their claimed reductions through reliable monitoring systems, transparent data records, and auditable methodologies face delays in issuance, downward revisions in credit volumes, or rejection during validation or verification processes. As a result, MRV design directly influences the financial outcomes of a carbon project because it determines the portion of mitigation outcomes that can ultimately be converted into tradable credits.

Carbon standards require project developers to submit detailed documentation describing baseline conditions, monitoring systems, calculation approaches, and supporting datasets. Independent validation and verification bodies (VVBs) review this documentation, conduct audits, and assess whether the reported emission reductions meet the methodological requirements of the relevant carbon standard. This process typically includes examination of monitoring records, calibration logs for measurement equipment, field inspection reports, sampling procedures, and data management systems. Where evidence is incomplete or inconsistent with methodological requirements, the verification process may require corrective action requests or adjustments to reported emission reductions before credits can be issued.

For project developers and investors, the implication is that MRV should be treated as a core component of project design rather than an administrative requirement applied late in the project cycle. Well-structured MRV systems help ensure that measured mitigation outcomes can withstand independent scrutiny, reduce the risk of credit issuance shortfalls, and improve confidence among buyers evaluating the integrity of carbon credits.

The process of converting measured emission reductions into tradable carbon credits involves multiple institutional steps and associated costs. After a project developer prepares the project design documentation and monitoring framework, the project must undergo validation and verification by an independent validation and verification body (VVB), followed by registration and credit issuance through a carbon registry such as Verra, Gold Standard, or the Global Carbon Council. Each of these stages carries distinct professional and administrative costs that should be modeled separately when evaluating project economics.

VVB fees typically relate to professional services required to review project documentation, assess monitoring systems, and conduct validation and verification audits. Registry fees, by contrast, cover administrative processes associated with project listing, registration review, and the issuance of credits within the registry system. For example, Verra's updated fee schedule includes charges such as pipeline listing request fees, registration review request fees, verification review fees, and an issuance levy applied per Verified Carbon Unit (VCU), with staged implementation dates beginning in late 2024 and early 2025. While these charges are generally small relative to capital expenditure in large infrastructure projects, they can represent a meaningful cost component for smaller projects and programmatic activities, particularly when combined with national policy deductions and brokerage costs in the final revenue stack.

Table 3 provides indicative development and issuance timelines for different carbon project types, based on observed project cycles under major carbon standards and typical execution conditions in emerging markets. The timelines reflect two key stages in the project lifecycle: the period required to move from project development to formal registration, and the time required from project initiation to the first issuance of carbon credits. Variations across project types are largely driven by differences in monitoring requirements, baseline establishment, and the complexity of verification processes. In Pakistan's context, additional factors such as data availability, land tenure documentation, installation of monitoring equipment, and coordination with local stakeholders can further influence project timelines. The notes column highlights common sources of delay or variance observed in similar projects, providing a practical indication of where project developers may encounter execution risks during validation, monitoring, and verification.

Table 3. Indicative Timeline by Project Type

Project type	Typical development-to-registration timeline (months)	Typical first issuance timeline from start (months)	Notes that commonly drive Pakistan variance
Landfill methane / wastewater methane	9–15	18–30	Metering installation and commissioning; baseline data gaps; municipal governance and site access
Mangrove/blue carbon / ARR	12–24	24–48	Tenure + leakage/permanence; field plot establishment; mandatory site visits; buffer determinations
Bagasse cogeneration / biomass	6–12	15–24	Seasonality; export metering; fuel accounting; regulatory surplus checks
Industrial waste heat recovery	6–12	12–24	Metering calibration; production-linked baselines; documentation quality
Livestock biogas (programmatic)	9–18	18–36	Usage evidence; sampling design; maintenance and sustained performance

Brick kiln modernization	9–18	18–36	Regulatory mandates reduce additionality; fuel substitution evidence; dispersed sites
Electric bus fleets	9–18	18–36	Route telemetry integration; diesel baseline proof; grid EF sensitivity
Utility solar (selective)	6–12	12–24	Additionality scrutiny; curtailment and dispatch risk; EF trend
Smallholder agroforestry	12–24	24–48	Tenure aggregation; leakage; remote audit limitations; survival monitoring
BESS (emerging)	Case-specific	Case-specific	Methodology/baseline uncertainty; dispatch modeling; data access

The financial value of a carbon project ultimately depends on the number of credits issued after verification and the deductions applied during commercialization. In Pakistan, developers must model revenues net of national policy parameters where applicable. Publicly available policy guideline copies describe (i) a 5% deduction of credits at source, (ii) a 1% administrative fee on gross revenues, and (iii) a 12% corresponding adjustment fee on net revenues for outcomes requiring corresponding adjustments, with revenue-sharing alignment between provincial allocations and a national climate fund. This structure implies that, for an authorized ITMO pathway, developers may face a multi-layer deduction stack before accounting for broker fees, registry fees, and VVB costs. For non-authorized voluntary carbon market outcomes framed as contribution claims, the applicability of corresponding adjustments and the CAF can differ depending on policy interpretation and authorization status. In practice, this means that government authorization decisions increasingly influence both the claims that can be made by buyers and the net revenues available to project developers.

Implications of Weak MRV Frameworks

Projects that lack robust monitoring, reporting, and verification systems face significant risks during the validation and verification process. In carbon markets, emission reductions must be demonstrated through documented data, consistent monitoring procedures, and evidence that aligns with the requirements of the applicable methodology. Where monitoring systems are incomplete, measurement equipment is not calibrated, or supporting documentation is inconsistent, verification bodies may issue corrective action requests or require revisions to reported emission reductions. In practical terms, this can result in delayed credit issuance, downward adjustments in the number of credits issued, or in severe cases rejection of monitoring reports for a given crediting period. Weak MRV frameworks can therefore translate directly into financial risk for project developers and investors, as a portion of the theoretical mitigation outcome may not be converted into verifiable and tradable carbon credits. As carbon markets increasingly emphasize integrity and transparency, projects that invest early in reliable monitoring systems and clear data governance are more likely to achieve predictable issuance outcomes and maintain buyer confidence.

Illustrative Sensitivity Analysis: Revenue Outcomes for a Grid-Displacement Carbon Project

Financial outcomes for carbon projects depend heavily on assumptions about emission factors, carbon prices, and verification schedules. Table 4 shows a simplified screening model for a hypothetical grid-displacement project producing 100 GWh/year of exported electricity, using three grid emission factor scenarios and three carbon price scenarios, and comparing annual versus biennial verification. The purpose is not to represent any one project but to show that (i) EF is a first-order driver of credit volume, (ii) verification frequency affects cash flow timing and audit cost intensity, and (iii) Pakistan policy deductions (when applied) mechanically reduce net revenue. The model assumes a 5% credit deduction and 1% gross admin fee and, in a worst-case conservative view for authorized transfers, treats CAF as applying to revenue after the admin fee but before other costs (developers should adjust once official implementation guidance defines the deductible base more precisely).

Table 4. Sample Financial Sensitivity Table (Illustrative; 100 GWh/year export; Revenue in USD/year)

Grid EF (tCO_2e/MWh)	Carbon price (USD/t)	Gross credits (t/yr)	Credits sold after 5% deduction (t/yr)	Gross sales (USD/yr)	Admin fee 1% (USD/yr)	CAF 12% (USD/yr, conservative base)	Net revenue before registry/VVB/broker (USD/yr)
0.40	3	40,000	38,000	114,000	1,140	13,543	99,317
0.40	8	40,000	38,000	304,000	3,040	36,355	264,605
0.40	20	40,000	38,000	760,000	7,600	90,912	661,488
0.50	3	50,000	47,500	142,500	1,425	16,929	124,146
0.50	8	50,000	47,500	380,000	3,800	45,144	331,056
0.50	20	50,000	47,500	950,000	9,500	112,860	827,640
0.60	3	60,000	57,000	171,000	1,710	20,315	148,975
0.60	8	60,000	57,000	456,000	4,560	54,173	397,267
0.60	20	60,000	57,000	1,140,000	11,400	135, 432	993,168

The grid emission factor should not be assumed constant through 2026–2040. A UNFCCC-hosted proxy series used in a NAMA context shows a decline from ~0.67 tCO_2e/MWh in 2015 to ~0.40–0.43 in 2022–2025, with a modest uptick in 2023 and stability around 0.43 through 2025. Even if one treats these as "proxy" rather than as the combined margin required under specific methodologies, the direction is important: grid-linked credit volumes can decline materially over time, particularly if policy drives more renewables or if gas replaces coal at the margin. Investors should therefore include EF as an explicit downside risk in Pakistan renewable, efficiency, and electrification projects.

A high-level project cycle timeline that matches typical Pakistan execution constraints is shown below. The timeline is intentionally conservative because the binding constraint is often not the writing of documents but the closure of VVB findings, host authorizations, site access, and data readiness.

Table 5. Typical Pakistan Carbon Project Timeline (Idea to First Issuance)

Phase	Activity	Indicative Duration	Cumulative Timeline
Origination & Screening	Pre-feasibility screening and data room readiness	45 days	Month 1–2
	Methodology selection and additionality strategy	45 days	Month 2–3
Design & Stakeholder Process	PDD drafting, monitoring plan development, baseline construction	90 days	Month 4–6
	Stakeholder consultation and safeguards documentation	45 days	Month 7–8
Validation & Registration	VVB validation and CAR/CL resolution	120 days	Month 9–12
	Registry review and formal registration	60 days	Month 13–14
Monitoring & Issuance	Monitoring period (minimum credible window)	365 days	Month 15–26
	VVB verification and issuance request	120 days	Month 27–30
	Credit issuance and first sale settlement	30 days	Month 31

Finally, Table 6 presents a Pakistan-specific risk matrix highlighting risks that are empirically visible in Pakistan's policy and sector context, including policy deductions and authorization uncertainty, declining grid emission factors, data system weaknesses in waste and AFOLU sectors, and macro-financial variables such as interest rates and exchange rate volatility that can materially affect additionality assessments and project returns. The matrix is intended as an indicative overview of commonly observed risk categories rather than an exhaustive list. In practice, the risk profile of each carbon project will depend on project design, location, sector characteristics, and financing structure, and can only be fully assessed through detailed feasibility studies and due diligence during project development.

Table 6. Pakistan-specific Risk Matrix with Mitigation Measures

Risk	Where it is most binding in Pakistan	Likelihood (2026)	Impact	Mitigation that is practical for developers/investors
Authorization and policy fee uncertainty	Article 6/ITMO projects; high-profile public assets	High	High	Model fee stack explicitly; choose pathway (authorized vs non-authorized) early; engage host authorities during PDD drafting; structure contracts with policy-change clauses
5% credit deduction and revenue fees reduce net	Any project that is authorized / subject to national fee framework	High	Medium–High	Underwrite to net-of-policy price; target higher-integrity price bands; use offtake structures that share policy wedges transparently
Additionality failures in renewables	Utility solar/wind; grid-connected projects	Medium–High	High	Use barrier/investment analysis with Pakistan-specific cost of capital; focus on constrained grids, curtailment mitigation, or clearly incremental capex
Grid EF declines reduce credit volumes	Renewables, efficiency, electrification	Medium	Medium–High	Stress-test EF; adopt shorter verification cycles early; diversify portfolio toward methane/AFOLU where EF is less binding
Weak municipal data systems	Waste projects	High	High	Build data systems: weighbridges, compositional studies,

				audited logbooks; secure site access agreements; third-party corroboration
Tenure/leakage/permanence disputes	Mangroves, agroforestry	Medium–High	High	Legal due diligence on land rights; community benefit-sharing agreements; conservative baselines; buffer and monitoring budgets
Auditor access and field logistics	Remote AFOLU and dispersed programs	Medium	Medium	Plan for required site visits; budget for travel/security; use hybrid MRV (remote + field) and robust sampling
Macro volatility affects IRR and additionality	All capex-heavy projects	Medium	Medium–High	Use scenario discount rates; hedge where possible; denominate contracts carefully; align financing with revenue currency and timing
Counterparty and Offtakers default	Forward sales and ERPAs	Medium	High	Creditworthy offtakers; payment security (LCs, escrow, step-in rights); diversify buyers; robust legal terms
Reputational/integrity shocks	AFOLU and programmatic credits	Medium	High	Transparent disclosures; independent ratings where beneficial; conservative accounting; avoid aggressive baseline claims

07 Resources Future: Technical Advisory for Carbon Projects

In Pakistan in 2026, carbon credits need to become a design decision integrated with any project's feasibility, not an afterthought after project has been implemented. Projects can be monetized via spot sales after issuance, forward offtake contracts (ERPAs) that provide price certainty, prepayment structures that provide development capital against future delivery, and, where eligible and authorized, Article 6 pathway transfers that may command premiums but also trigger national fee structures and accounting obligations. The choice among these is not purely financial; it interacts with MRV design, timing of issuance, and claims language demanded by buyers.

Spot monetization is most realistic for smaller volumes and for projects that can reach issuance without external capital. Its weakness is price and liquidity risk in a market where buyers are selective and reputationally sensitive. Forward offtake structures are increasingly important because they can convert an uncertain spot revenue stream into bankable cash flows, but they require creditworthy counterparties and robust delivery risk allocation. Market analytics indicate that 2025 saw a major expansion of offtake deals and that forward markets price high-durability removals at large premiums, though most Pakistan near-term projects will not fall into durable removal bands; the relevant lesson is that credible integrity attributes and delivery certainty drive access to forward capital.

Article 6-linked monetization should be treated as a separate investment pathway. Under Article 6.2 cooperative approaches, the presence of national authorization, corresponding adjustments, and fee schedules implies that developers must plan for an additional layer of documentation, approval, and accounting. The policy guidelines' parameters (5% deduction, 1% admin fee, 12% CAF) make the net price realized by the developer structurally lower than the buyer's headline price, which can be acceptable only if (i) authorized credits sell at a premium sufficient to cover the wedge and (ii) the project values compliance adjacency or sovereign-backed integrity. The first LOI issued for the Mehmood Booti project under Article 6.2/VCM provisions indicates that, at least for flagship projects, government may be prepared to engage early. The investor implication is that Article 6 monetization in Pakistan is likely to be concentrated first in a small number of visible projects with strong institutional sponsors and clear public-benefit narratives, rather than in a broad-based market across all developer types.

Within this environment, RF's role as a project advisor is most valuable when framed as de-risking measurable bottlenecks rather than as generic carbon consulting. The spend and time sinks that repeatedly determine whether Pakistan projects reach issuance are: the ability to build an investable screening memo with credible baseline and additionality hypotheses; the discipline to assemble Pakistan-specific activity and regulatory evidence into a PDD that survives VVB scrutiny; the design of an MRV system that is auditable in Pakistan's data environment; and the ability to manage VVB validations/verifications and address corrective actions without timeline blowouts. A secondary but increasingly important function is commercialization: selecting a monetization pathway that matches the project's integrity class and the policy pathway (authorized versus non-authorized) and that correctly prices Pakistan policy deductions into net proceeds.

How can Resources Future (RF) Support You?

Resources Future (RF) is a climate and carbon advisory firm that supports organizations across the lifecycle of carbon project development. The firm works at the intersection of climate policy, project finance, and technical implementation to help translate mitigation and removal activities into credible carbon assets that can be registered under voluntary carbon markets and Article 6 mechanisms. RF has supported engagements with development partners, multilateral institutions, and private sector project developers across emerging markets.

RF's services align with three key stages of the carbon project lifecycle. At the early stage, RF conducts carbon viability screening to assess whether a project is suitable for carbon credit generation and to identify the appropriate registry pathway. Once viability is established, RF provides detailed technical and carbon feasibility analysis, including project design, carbon modelling, and financial assessment. For projects moving forward, RF supports end-to-end project development, including Project Design Document preparation, methodology alignment, MRV framework design, coordination with validation and verification bodies, and support through registration and issuance cycles.

This lifecycle-based approach enables project developers and investors to move from initial opportunity screening to a registered carbon project with credible monitoring, verification, and issuance outcomes.

Through this approach, RF supports developers and investors in translating climate mitigation activities into credible carbon assets that meet registry requirements and evolving market integrity expectations. The focus is on ensuring that projects entering the carbon market are supported by defensible baselines, robust monitoring systems, and clear documentation capable of withstanding validation and verification processes. This allows project proponents to move from conceptual opportunities to projects that can realistically generate and monetize carbon credits in an increasingly selective market environment.

08

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