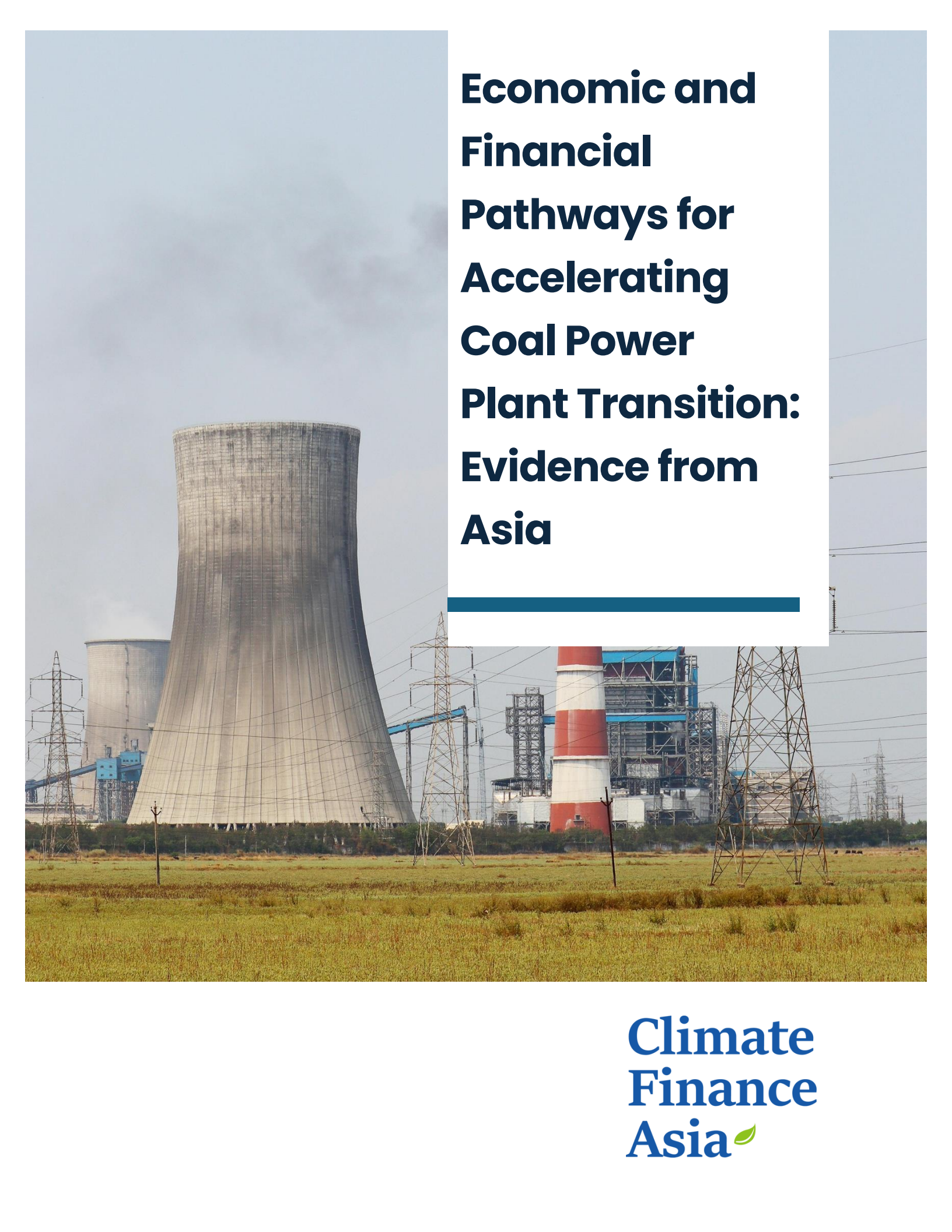




Economic and Financial Pathways for Accelerating Coal Power Plant Transition: Evidence from Asia

**Climate
Finance
Asia** 

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Introductory Remarks

Retiring coal-fired power plants (CFPPs) is crucial for global decarbonization, particularly in developing Asia, where coal accounts for a significant portion of electricity generation and emissions. Transition from coal to renewable energy is essential to meet international climate targets, but success hinges on economic and financial feasibility. Early coal plant retirement poses complex financial challenges: many facilities have long remaining lifespans, outstanding loans, and vital roles in the energy supply, making premature retirement economically difficult and deteriorating energy security. The coal phase-out will remain slow without robust incentives and financing solutions to address stranded assets, debt repayment, and decommissioning costs. Thus, economic and financial considerations are central to enabling the transition away from coal.

This report focuses on four countries, Indonesia, Bangladesh, Pakistan, and Malaysia, chosen to represent a spectrum of energy system maturity and coal reliance. Indonesia is a large emerging economy with abundant coal resources and a high dependence on coal-fired power. Bangladesh and Pakistan are rapidly growing economies with newer coal power additions, having recently incorporated new coal power plants into their electricity mix to meet rising demand. Malaysia, by contrast, is a more advanced economy with a diversified power generation mix and a more moderate reliance on coal. By examining such varied contexts, the study illustrates how differences in development stage and coal dependency influence the financial and policy approaches to retiring coal plants.

The study employs a qualitative case study approach, based on in-depth interviews with key stakeholders involved in the coal transition. Semi-structured interviews were conducted with two main groups: coal-fired power plant owners/operators and financial institutions involved in energy finance. The financial institutions interview included commercial banks, national policy banks, and multilateral development banks, capturing both private-sector and public-sector perspectives on financing. Engaging asset operators and capital providers provides a dual perspective on the challenges of coal plant retirement. To our knowledge, this is the first study in Asia to pair facility-level insights from coal power plants with perspectives from financial institutions, offering a novel and policy-relevant contribution by revealing the financial dynamics of early coal retirement.

The interviews revealed a range of challenges and potential solutions voiced by both stakeholder groups. Plant owners emphasized the financial burdens of early coal retirement, including unrecovered capital investments, decommissioning costs, and the risk of stranded assets. They also expressed concerns over grid reliability, policy uncertainty, and regulatory constraints, particularly long-term power purchase agreements (PPAs) that limit flexibility. Financial institution representatives highlighted additional challenges, such as

regulatory and market uncertainties, credit risks tied to coal assets, and a lack of bankable green projects to support as viable alternatives.

A key pathway involves using transition finance tools, such as tailored green bonds, green sukuk in Islamic countries, and blended finance, supported by government-backed guarantees to de-risk investments are essential. These instruments can help refinance coal assets and fund cleaner alternatives. Reforming market distortions, including widespread coal subsidies, implementing efficient carbon pricing mechanisms, and developing standardized taxonomies and impact tracking are critical to accelerating the transition.

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Literature Review

Policy Landscape for Coal Phase-Outs in Developing Asia

International Agreements and Commitments

The international commitment to coal phase-outs has gained significant momentum in recent years. The momentum, driven by landmark agreements such as the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, and subsequent Conferences of the Parties (COP) meetings, has led to the establishment of robust guidelines and goals toward mitigating climate change through coal phase-out initiatives. These initiatives focus on reducing carbon emissions and promoting renewable energy alternatives. For instance, the UNFCCC has consistently underscored the need to phase out coal as part of global climate action. Notably, during

COP26, which was held in Glasgow in 2021, approximately 200 countries united under the Glasgow Climate Pact, emphasizing limiting the global temperature rise within 1.5°C above pre-industrial levels. The pact initiated the concept of 'phasing down,' unabated coal power, and highlighted the necessity of a just transition to support vulnerable communities affected by the transition from coal. Additionally, the pact has strengthened further international unity and resolve by explicitly marking the 'beginning of the end of the fossil fuel era' and reinforcing the priority of coal phase-out as a key climate priority while stressing that the 'phase-out of coal is a key climate priority' for achieving global climate goals. (COP26 Presidency Outcomes, 2021; UNFCCC, 2021; UNFCCC, 2023a; UNFCCC, 2023b).

In addition, other international organizations have been playing a critical role in supporting coal transition policies. Four key institutions include the International Energy Agency (IEA), the International Renewable Energy Agency (IRENA), the World Bank, and the Organisation for Economic Cooperation and Development (OECD), all of which are shaping coal transition policies globally by providing research and policy guidance as well as work towards facilitating financial mechanisms in support of countries in their transition away from coal. Firstly, the IEA has been at the forefront of advocating for just transitions in the coal sector, publishing multiple reports that aim to emphasize the importance of energy transition. To name a few, their report "Accelerating Just Transitions for the Coal Sector" and "Coal in Net Zero Transitions" emphasize and outline strategies for a secure energy transition whilst maintaining economic stability and social equity, taking a people-centered approach to coal phase-out. Secondly, IRENA focuses on setting renewable energy targets and providing guidance on designing policies that can be effectively integrated into national energy grids. For instance, their report, "Renewable Energy Targets in 2022: A Guide to Design," is a practical tool for policymakers to align national strategies with global climate goals. Thirdly, the World Bank is pivotal in financing energy transitions through initiatives such as the "Scaling Up to Phase Down"

framework, which offers financial and technical support to developing countries aiming to phase out coal. This approach addresses economic barriers and promotes long-term investments in renewable infrastructure. Furthermore, the World Bank reinforces the need for financial innovation and risk-sharing mechanisms to support coal-dependent economies. These combined efforts from leading international institutions highlight the multifaceted approach needed to ensure a smooth and equitable transition from coal to renewable energy. (IEA, 2023a; IEA, 2023b; IRENA, 2022; World Bank, 2023a; World Bank, 2023b).

Latterly, the focus has recently shifted to aligning climate finance and energy transition to promote social and economic equity. The United Nations Development Programme (UNDP) underscores the critical role of sustainable energy transitions in tackling climate change and promoting broader development goals. According to the UNDP, integrating climate finance with development strategies can enhance job creation, economic diversification, and social inclusion. Initiatives such as Just Energy Transition Partnerships (JETPs) are credited for this shift in the global perspective. JETPs aim to support coal-dependent countries in transitioning to renewable energy by providing financial and technical assistance while ensuring that vulnerable communities are not left behind. This model was initially launched in South Africa and has been successfully replicated in countries such as Indonesia and Senegal, showcasing how international collaboration can drive a fair transition for other countries to follow. In this context, one of the most recent examples of such efforts is the Facility-level Just Transition Guidelines for Banks, jointly developed by Climate Finance Asia (CFA), leading international NGOs, and philanthropic groups. The guideline is a first-of-its-kind framework to help financial institutions integrate just transition considerations into project-level financing decisions. Lastly, the OECD emphasizes transparency and robust standards in aligning climate finance with net-zero and climate-resilient pathways. Many of their publications and reports emphasize the prevention of greenwashing and

ensuring that financial institutions adopt evidence-based practices when investing in green projects. (UNDP, 2024; Institute for Human Rights and Business, 2024; IHRB, 2024; OECD, 2024; Climate Finance Asia, 2025).

National Energy Transition Policies on Coal Phase-Outs (in Case Study Countries)

Indonesia

Indonesia's energy transition efforts include an interplay of policies, regulations, and financial mechanisms to reduce coal dependence, as the government commits to achieving net-zero emissions by 2060. Indonesia's energy mix is heavily weighted towards coal, accounting for approximately 60% of the national electricity generation capacity. (Wijayanto et al., 2025; Silviana et al., 2025).

At the policy level, Indonesia's Electricity Supply Business Plan (RUPTL) 2021–2030 outlines a strategic shift away from coal, and Indonesia's National Electricity Master Plan (RUKN) 2024–2060 report reaffirms this direction, highlighting the planned early retirement of coal-fired power plants. Furthermore, the government's "no new coal" policy post-2023, coupled with the ambitious 35,000 MW power plant investment program, underscores the balancing act between meeting energy demand and transitioning to cleaner alternatives. Taking a deeper look into the country's financial mechanisms, Indonesia is exploring international support through frameworks such as the Just Energy Transition Partnership (JETP) and the Asian Development Bank's Energy Transition Mechanism to address the socioeconomic impacts of coal plant retirements, such as job losses and stranded assets. A multi-level governance approach, as seen in the Pelabuhan Ratu power plant's early retirement policy, emphasizes the need for more transparent regulatory frameworks, robust community engagement, and alignment with Indonesia's Nationally Determined Contributions (NDCs). However, despite taking these

initiatives, significant challenges, such as the economic feasibility of transitioning to renewables, managing potential electricity shortages, and ensuring a just transition for affected workers, are ongoing concerns. Indonesia's Low Emissions Analysis Platform (LEAP) scenarios suggest that while the business-as-usual scenario is the most cost-effective, a coal phase-out approach aligns better with long-term climate goals, requiring substantial investments estimated at USD 114.6 billion. (Kementerian ESDM, 2024; Cui et al., 2022; Silviana et al., 2025; Do & Burke, 2024; Wijayanto et al., 2025).

Malaysia

Malaysia will gradually and definitively transition away from coal as part of its broader strategy towards net-zero emissions by 2050. The planned phasing out of all CFPPs by 2044 is a key milestone in the transition initiative, with an interim target of reducing coal reliance by 50% by 2035. This initiative is further supported by the absence of new coal-fired power plant developments post-2040, ensuring that no additional coal-based capacity is added to the energy mix. Additionally, Malaysia's transition plan emphasizes the role of natural gas as a bridging fuel, anticipating that it will make up over half of the total primary energy supply (TPES) by 2050. This transition is guided by the National Energy Transition Roadmap (NETR) and the National Energy Policy 2022–2040 (NEP), both of which outline Malaysia's long-term energy transformation strategy. The NETR highlights Malaysia's commitment to increasing its renewable energy (RE) share to 70% by 2050, replacing coal with sources such as solar, biomass, and waste-to-energy technologies. Additionally, it promotes grid modernization and the establishment of the Malaysia Energy Exchange, enabling cross-border trade of renewable electricity. (Reccessary, 2024; The Edge Malaysia, 2024; Government of Malaysia, 2022; Ministry of Economy, 2023; Ministry of Economy, 2023)

Despite these ambitious goals, challenges remain in accelerating the transition. The government has acknowledged the potential economic disruption this

transition may cause and has outlined reskilling programs to support affected workers in shifting to renewable energy jobs. In addition, studies indicate that Malaysia's renewable energy adoption is still far below its intended targets, with only 19% of its electricity generated from renewables as of 2022, due to factors such as high initial costs, grid reliability concerns, and the continued availability of fossil fuel subsidies have slowed progress. Additionally, the country's historical reliance on coal and natural gas for industrial development has made the transition complex. (The Edge Malaysia, 2024; Abd Aziz et al., 2024; Government of Malaysia, 2022)

To address these challenges, Malaysia's National Energy Policy 2022–2040 incorporates financial incentives, public-private partnerships, and international cooperation to support renewable energy investments. The policy also promotes technological advancements in energy storage, carbon capture, and hydrogen energy, aiming to balance economic stability with environmental commitments. However, the pace and success of this transition will depend on effective policy implementation, investment in renewable energy infrastructure, and workforce adaptation to new energy sectors. (Government of Malaysia, 2022; The Edge Malaysia, 2024; Ministry of Economy, 2023).

Pakistan

Pakistan's energy transition efforts are gradually evolving as the country grapples with structural challenges, including a relatively young coal fleet, long-term PPAs, and a rising fiscal burden. Most CFPPs have only been operational for 6–7 years yet suffer from low utilization and high fixed-capacity payments, which are expected to total nearly PKR 395 billion in FY2024–25. In response, Pakistan is increasingly engaging with international mechanisms to accelerate its coal transition. The Asian Development Bank's Energy Transition Mechanism (ETM) is being explored for early retirement of high-emitting assets such as the Sahiwal coal plant, while Just Energy Transition Partnerships

(JETPs) and the Coal to Clean Credit Initiative (CCCI) are under consideration to mobilize climate finance and enable a just transition. To operationalize these initiatives, stakeholders have recommended renegotiating PPAs, introducing carbon pricing, and leveraging Chinese involvement under the CPEC framework. To secure international support, design region-specific plans, and reskill affected workers, a dedicated working group for a CP-JETP model has been proposed. Despite institutional and regulatory constraints, Pakistan is gradually aligning itself with global transition strategies by exploring blended finance, public-private partnerships, and just transition principles in its policy approach. (Babar & Waleed, 2024; Ghauri et al., 2023; Raza & Cucculelli, 2024; Ahmed et al., 2024).

Bangladesh

Bangladesh's energy landscape has been shaped by ambitious national goals such as Vision 2041, which aims for 10,888MW of renewable energy by 2030. However, fossil fuels, particularly natural gas, have dominated this rapid growth, raising sustainability concerns in the face of a growing overcapacity crisis. As of 2024, the power sector is under fiscal strain, relying heavily on government subsidies to cover shortfalls and escalating generation costs. (Mahbub, 2024; Hossain et al., 2023; IEEFA, 2024).

To cope, the government has adopted a National Solar Energy Action Plan to shift toward sustainability. It targets 40,000 MW of renewables by 2041, alongside demand-side energy efficiency programs and efforts to reduce grid losses and load shedding. Policy reforms are also underway to attract private-sector investment, streamline approvals, and revise tariff structures to reflect long-term costs (IEEFA, 2024; Moazzem & Sadik, 2024).

Despite these advancements, infrastructure bottlenecks and limited access to affordable capital remain persistent obstacles to large-scale renewable deployment. Bangladesh is balancing its energy access goals with

decarbonization imperatives, aiming to reduce fossil fuel dependence while ensuring affordability and reliability for its population. (Sagor et al., 2023).

Barriers to Early Coal Plant Retirement

While progress is evident across case studies, several barriers inhibit coal phase-outs, particularly in emerging economies.

Economic and Financial Barriers

Early coal plant retirement poses significant financial challenges for governments and investors, particularly in developing countries where many plants are still relatively young. Nedopil et al. (2024) examined six Chinese-sponsored CFPPs in Vietnam and Pakistan and found that while refinancing can enhance enterprise value and support early retirement, younger plants face higher opportunity costs due to more remaining operational years. This implies that plant-level characteristics such as contract maturity, technology type, and ownership structure must be considered when designing retirement schemes, as a one-size-fits-all approach risks creating perverse incentives. Vietnam, for instance, demonstrates greater refinancing viability due to higher utilization rates and a more diversified investor landscape. In contrast, Pakistan's younger plants struggle with high fixed capacity payments and unclear contract structures. This divergence indicates that national regulatory and financial contexts are crucial in determining whether early retirement is financially feasible.

In many less developed countries such as Bangladesh and Pakistan, coal-fired power plants play a central role in ensuring energy security by providing a reliable and dispatchable source of electricity. Coal's baseload characteristics support industrial production, stabilize the grid, and help meet peak demand in regions where renewable alternatives remain underdeveloped or intermittent. As such, early retirement of these plants may threaten grid

reliability and lead to power shortages, particularly where infrastructure for alternative energy sources such as gas, hydro, or storage is either underfunded or politically sensitive. This deep reliance on coal-based generation creates a policy dilemma, as governments must weigh the long-term benefits of decarbonization against the short-term risks of energy insecurity. The risk of deteriorating energy security makes policymakers hesitant to pursue early closures, even when financing tools are available. (Taghizadeh-Hesary & Yoshino, 2019; Rauf et al., 2015)

Furthermore, if implemented without structural reforms, refinancing may merely postpone, rather than resolve, carbon emissions lock-in. Notably, research highlights the significant risk of stranded assets associated with early retirement, especially when sunk costs in coal infrastructure have yet to be recovered. Studies also warn that early retirement policies lacking proper structuring could inadvertently incentivize further fossil fuel investment, especially if transition finance is misused. For instance, transition-linked refinancing could fund coal efficiency upgrades or biomass co-firing under the guise of climate action, extending plant life rather than accelerating closure. (Kachi et al., 2024)

The IEA notes that the high capital intensity of clean energy infrastructure makes the availability of affordable financing critical, especially in developing economies. Despite renewables becoming cost-competitive globally, existing coal plants often remain shielded by fixed contracts or market distortions, such as subsidies or preferential dispatch, which limit the financial appeal of switching to clean alternatives. This creates a disconnect between environmental needs and market logic. These distortions slow market correction and crowd out renewable investments since utilities locked into legacy baseload contracts cannot make space for new clean energy capacity on the grid. (IEA, 2023c)

According to Kefford et al. (2018), decommissioning costs alone can range significantly depending on the plant's age, location, and environmental liabilities. They underscore that financial instruments must be designed to internalize these costs, particularly in decarbonization scenarios. Failure to plan for decommissioning often leads to abandoned infrastructure or incomplete site remediation, which can carry long-term environmental and social costs for local communities. Furthermore, market distortions such as fossil fuel subsidies impede clean energy competitiveness. As noted in the Global China Initiative report, opaque financial structures and state support often obscure the actual cost of coal power, perpetuating its dominance in energy mixes. This opacity prevents accurate valuation of coal assets, inhibiting the development of credible exit strategies for governments and private financiers. (BU GDP Center, 2024c).

Even when early retirement is politically supported, practical financing tools remain generally underdeveloped. The SGFIN industry report (2024) outlines that while carbon credits and concessional finance could bridge the gap, existing markets are not robust enough to consistently deliver the scale of funding required. South-South carbon trading or voluntary offset markets may hold potential; however, their volatility and reputational risks make them unreliable for long-term asset retirement planning. This stems from the phenomenon that the volatility of voluntary carbon markets further undermines investor confidence, making it challenging to price long-term retirement deals or build bankable financial pipelines. Similarly, the "Leaving No One Behind" report by Neyen (2023) argued that successful early retirement strategies must be accompanied by comprehensive financial planning that includes long-term cost recovery and transitional support. This includes pre-arranged operator compensation models, fiscal buffers for grid upgrades, and social transition funds for affected communities, none consistently embedded in current financing pipelines.

Regulatory and Institutional Challenges

Regulatory and institutional barriers significantly hinder the early retirement of coal-fired power plants, especially in developing Asian countries. A key challenge is the absence of predictable regulatory frameworks, discouraging long-term investment in clean energy. As Younas and Usmani (2024) explained, Pakistan's regulatory ambiguity, particularly under the CPEC agreements, creates uncertainty for investors considering early coal retirement and hinders negotiations for alternative energy sources. This uncertainty is not merely a lack of policy clarity; it reflects deep-seated fragmentation in institutional responsibilities, where energy, finance, and investment authorities often operate on parallel tracks without shared transition timelines or governance mandates. In such environments, transition plans stall not due to lack of will but because no single actor has the power or the incentive to coordinate across agencies.

Another major obstacle is the lack of carbon pricing mechanisms across most DEVELOPING ASIAN countries. The Boston University Global Development Policy Center (2024a) notes that market incentives remain skewed in favor of coal without a carbon price signal, making clean energy alternatives less financially competitive. However, the issue is more profound than simply the absence of a price; it indicates an institutional bias favoring the protection of existing energy frameworks. In these scenarios, many state-owned utilities financially rely on coal-related revenues or are subject to political pressures to maintain artificially low electricity costs. The absence of carbon pricing diminishes the economic rationale for decommissioning coal operations while simultaneously reinforcing the political incentives for postponement, particularly in nations where coal is not only central to electricity generation but also crucial for employment, local investment, and debt obligations service.

Additionally, renegotiating PPAs poses a bureaucratic challenge, particularly in jurisdictions where long-term contracts are protected under international law

or complex bilateral frameworks. As highlighted in Climate Bonds Initiative's transition finance guidelines (2023a), unclear guidance on restructuring PPAs has slowed progress in several coal-heavy economies and creates legal and reputational risks for both investors and governments. PPA clauses, especially those involving sovereign guarantees or take-or-pay provisions, create legal rigidity that limits governments' flexibility to accelerate decarbonization. Renegotiation may expose countries to arbitration, or credit rating downgrades, creating a regulatory "chill" where governments fear litigation more than they desire emissions reductions. This institutional inertia leads to what transition scholars call "policy lock-in," where technical and financial solutions exist, but legal frameworks lag decades behind, effectively paralyzing implementation.

Furthermore, the Boston University Global Development Policy Center (2024b) emphasizes the need for enabling institutions such as Asset Management Companies (AMCs) to manage stranded assets. However, the lack of standardized procedures and unclear asset transfer frameworks continues to delay implementation. AMCs have the potential to operate as de-risking intermediaries, buying out or warehousing distressed coal assets to free utilities from legacy contracts. However, in most DEVELOPING ASIAN countries, their role is underdeveloped or politically contested. Without clear legislative mandates, these entities lack the authority and the financing structure to play a proactive role in the transition.

Lastly, the Singapore Green Finance Centre (2025) stressed that financial institutions are constrained by regulatory misalignment between national transition plans and international net-zero commitments. Misaligned incentives, limited transparency, and weak policy coordination collectively undermine the credibility of transition pathways despite financial actors' willingness to support them. This misalignment often manifests in contradictory policy signals: ministries announce coal phase-out targets while simultaneously approving new coal-linked infrastructure or power subsidies. The result is a disincentive structure, where banks are exposed to reputational

and compliance risk if they support coal yet lack viable green investment channels due to slow permitting, unclear taxonomies, or missing bankability criteria. Thus, regulatory dysfunction is not just a barrier to implementation but also to belief. Investors do not trust the system to deliver on transition goals, and that scepticism becomes self-fulfilling.

Social and Labor Transition Challenges

The transition from coal has posed significant socioeconomic challenges in coal-dependent regions, particularly regarding employment disruption and community well-being. Gong and Lewis (2024) emphasize that although China has introduced policy strategies to address these challenges, the distribution of resources has been skewed toward coal-related businesses rather than labor and communities, which may limit the effectiveness of a just transition. This allocation bias reflects a broader power asymmetry, where large enterprises are more institutionally equipped to access state resources while individual workers, mainly migrant laborers and informal subcontractors, remain marginalized in transition planning. Moreover, without union involvement or strong civil society participation, displaced workers have limited bargaining power or representation in transition policymaking. They also highlight that China's centralized political context, lacking strong labor or civil society movements, may constrain grassroots engagement in transition planning, even as the state introduces workforce development and reclamation efforts. In such environments, establishing local transition task forces with civil society and municipal representatives could ensure the incorporation of bottom-up perspectives into transition plans.

The World Bank (2021b) outlines a structured approach to mitigating the social and labor impacts of the coal transition, dividing it into pre-layoff planning, assistance during layoffs, and post-layoff support. This includes income support, active labor market policies (ALMPs), and auxiliary services tailored to the needs of affected populations. However, the report also warns that post-

layoff recovery may be nearly impossible in mono-industry towns without broader economic diversification strategies, especially in regions already suffering from demographic decline and youth outmigration. In such cases, transition planning cannot stop at layoffs; it must address the long-term viability of local economies, which may otherwise face permanent shrinkage.

Haywood, Janser, and Koch (2021) quantified the welfare costs of coal job loss in Germany and find that most costs stem from reduced job quality in subsequent employment. Workers aged 31–49 are the most affected, and delaying the coal phase-out can reduce total welfare costs. This loss is not merely financial but social; workers often move from unionized, high-benefit employment into fragmented, low-wage sectors with less security, fewer protections, and weaker career progression, resulting in long-term erosion of social capital. In this sense, the just transition is not only about job quantity but also about job dignity. Wage insurance schemes, where displaced workers receive a top-up to their new salaries, can bridge the income gap and preserve living standards, particularly for mid-career workers. Additionally, re-skilling subsidies could be tied to labor market demand forecasts, helping workers transition into sectors with long-term security.

In China, the ripple effects of the coal phase-out on employment extend beyond the mining sector to coal consumption industries. Niu et al. (2024) found that while job losses are concentrated in mining, indirect impacts are significant in industries such as construction and transportation, suggesting the need for broader labor transition planning. Non-coal workers such as rail operators, repair crews, and logistics staff are often excluded from formal transition programs. Governments should fund labor value chain mapping studies to identify indirectly affected workers and expand eligibility for just transition assistance accordingly. In addition, affected sector representatives should be included in local Just Transition Councils, ensuring downstream voices are reflected in planning and benefit distribution. Castaneda Rodriguez et al. (2024) expanded this conversation by calling for a globally inclusive labor

transition framework. They argue that developing and developed nations face unique challenges in providing equitable, gender-sensitive, and inclusive support for displaced coal workers. In lower-income countries, this means first investing in basic institutions such as job placement centres and vocational schools that are often absent. International organizations, such as the ILO and World Bank, could support governments in creating foundational labor infrastructure as a prerequisite for just transition finance. Moreover, gender-sensitive planning must also be embedded in all stages. For instance, offering re-skilling stipends and childcare support to women in coal communities, many of whom work informally or as caregivers, can broaden participation and reduce vulnerability.

Lastly, the transition should be emotionally inclusive. Building narratives that frame former coal workers as “clean energy pioneers” rather than victims can reduce resistance and build public support. Transition campaigns emphasizing pride, regional resilience, and future opportunities can make policy uptake smoother and more humane. Ultimately, it is essential to understand that a just transition is about compensation and retraining and redesigning the transition process to redistribute power, dignity, and opportunity.

Strategies to Enhance the Economic Viability of Early Coal Plant Retirement

Power Purchase Agreement (PPA) Renegotiation

One of the key strategies to enhance the economic viability of early coal plant retirement lies in renegotiating PPAs, which often lock governments into long-term payments that hinder early exits. In many countries, particularly in Asia, independent power producers (IPPs) operate under long-term PPAs that guarantee returns regardless of actual demand, creating barriers to coal phase-out. Kartika and Muhyidin (2024) highlighted that in Indonesia, these

rigid PPAs, frequently signed under take-or-pay terms, create a coal lock-in effect, requiring the national utility PLN to pay for electricity even if it is not used. These contracts were often negotiated when host countries had limited bargaining power and are now protected under international investment treaties, exposing governments to potential legal and financial risks during renegotiation. Establishing inter-ministerial PPA task forces integrating energy, finance, and legal expertise could streamline reforms. Additionally, multilateral funders such as the ADB and World Bank could require greater contract transparency as a condition for transition finance.

With the emergence of bureaucratic challenges, public development banks are now essential for facilitating PPA restructuring. Kachi et al. (2024) explain that such banks can support governments and IPPs by providing legal reviews of PPAs and promoting mechanisms to terminate, replace, or repurpose them. These banks are encouraged to engage in transparent and competitive market processes to ensure efficient compensation payments do not incentivize new fossil fuel investments. To avoid moral hazard, compensation mechanisms must be carefully calibrated to reflect the true residual value of the asset, and investors should not be rewarded for maintaining polluting assets until they are paid to exit. This calls for independent valuation protocols and oversight mechanisms involving financial actors and civil society. In countries such as Indonesia, where institutional fragmentation complicates contract reform, establishing cross-ministerial task forces can improve coordination between energy, finance, and legal bodies.

Boute (2024) further analyzes how Just Energy Transition Partnerships (JETPs) in Indonesia and Vietnam consider PPA renegotiation as part of their decarbonization financing strategy. The study cautions, however, that compensating coal investors for early termination must be handled carefully to avoid legitimizing unjust investor protections under international investment treaties. The paper stresses the importance of aligning compensation mechanisms with broader climate justice objectives to prevent moral hazard

and ensure equity in the transition. Public disclosure of PPA terms, currently rare, would increase transparency and help prevent overcompensation. Development finance institutions could require such disclosure as a precondition for support. Timing also poses as a critical factor in this matter. Strategic renegotiation windows often emerge when plants approach refinancing stages or debt service transitions, which governments can leverage to minimize legal exposure and costs. Moreover, communities impacted by coal operations are rarely consulted in contract exit strategies. Introducing participatory review boards or social compensation audits could ensure that local voices help shape how transition funds are allocated and to whom.

Stranded Asset Management and Repurposing

Managing stranded assets and repurposing retired coal plants into low-carbon infrastructure is increasingly viewed as a cost-effective pathway to accelerate energy transitions. Chattopadhyay (2024) proposes a plant-level optimization model that helps policymakers evaluate retirement and repurposing options based on net revenue, system reliability, and labor impact. The model supports whether coal plants should be converted into storage hubs, renewable energy facilities, or decommissioned entirely. Notably, this model introduces a structured method for aligning asset retirement with both economic rationality and grid flexibility needs, offering planners a data-driven lens to assess “what to do” and “when to do it” for each site. However, its real-world deployment depends heavily on policy adoption, institutional capacity, and local-level technical data, making government engagement a key implementation enabler.

Suski, Hong, and Chattopadhyay (2022) explore the financial dimension of stranded coal assets using data from India and the Philippines. They demonstrate how stranded costs vary based on plant age, contractual obligations, and local electricity market structures, underscoring the

importance of tailored repurposing strategies in developing countries. In particular, they highlight how the presence of long-term PPAs or capacity payment schemes may delay plant closure even if repurposing is financially sound. This indicates that asset valuation models must integrate infrastructure value and legal, financial, and institutional constraints.

Furthermore, the World Bank (2021a) outlines practical use cases for repurposing coal infrastructure, such as converting sites into solar PV farms, synchronous condensers, or battery storage systems. The report also identifies key enablers for repurposing, including workforce retraining and transparent regulatory frameworks. Beyond these headline uses, coal plant sites often contain transmission lines, control rooms, and cooling systems that can be repurposed, if not technically, then administratively, to support the next generation of clean energy projects. For instance, decommissioned control centres could be adapted as microgrid command centres or community solar operation hubs, aligning digital infrastructure with energy decentralization goals.

Tassi and Kittner (2024) further argue that repurposing coal plants can generate substantial regional economic benefits if designed with community input. Their analysis of international case studies emphasizes that repurposing efforts must address infrastructure reuse and social and economic revitalization. Importantly, their work emphasizes that a repurposed site should be “technically feasible” and “socially regenerative,” producing local tax revenues, retraining opportunities, and long-term employment. This is particularly critical in mono-industry towns where coal exits can leave deep socioeconomic voids. Despite being economically vulnerable, these non-coal workers, such as rail operators, machine maintenance crews, and logistics staff, are often left out of formal transition programs. This highlights the need to comprehensively map and support the full coal value chain workforce, not just miners or plant operators. Moreover, international case studies show that repurposing can catalyse cultural and civic transformation. In some regions,

former coal sites have been turned into community learning centres or environmental education hubs, preserving local identity while signalling a break from fossil dependency. Further examples include ash pond reclamation for agriculture or wetland restoration and turning ecological liabilities into climate adaptation assets.

Market-Based Incentives

Market-based incentives have emerged as critical tools to improve the financial feasibility of early coal plant retirement. One promising approach is reverse auctions, where plant operators competitively bid for compensation in exchange for early closure. This method has succeeded in Germany and is considered a model in developing countries to ensure fair pricing and cost-effectiveness. In Germany, over 2.3 GW of coal capacity was retired under this mechanism, with auction prices ranging between €60–€150/MWh depending on age and region. However, such schemes require high institutional capacity to set appropriate bidding ceilings and prevent collusion, challenges that many developing countries may face without technical assistance. Moreover, reverse auctions raise deeper equity concerns about who should be compensated under these schemes and how public funds should be allocated to ensure fairness rather than rewarding recent fossil fuel investments. (Columbia Center on Sustainable Investment, 2024).

Carbon pricing and emissions trading mechanisms are increasingly recognized as essential levers. The Monetary Authority of Singapore (MAS), in collaboration with McKinsey & Company, introduced the idea of using "transition credits," a form of high-integrity carbon credits tied directly to the emissions reductions from retiring coal-fired power plants. These credits serve as an additional revenue stream and aim to incentivize earlier decommissioning by making the economic case more viable. What distinguishes transition credits is their ex-post issuance, contingent on verified emissions reductions relative to a plant's historical baseline. However, the

scalability of such credits remains uncertain in the absence of strong Monitoring, Reporting, and Verification (MRV) infrastructure and straightforward integration with Article 6.4 of the Paris Agreement. Questions remain about credit ownership and distribution and whether benefits should accrue primarily to developers, governments, or multilateral institutions. These considerations are pivotal to designing equitable incentive systems. (MAS & McKinsey, 2023).

Furthermore, public funders can use mechanisms such as debt buyouts, guarantees, or concessional loans to support the managed phase-out of coal assets. These instruments align financial flows with climate targets while mitigating investor risks. Tools such as coal transition bonds or asset-backed instruments allow investors to recoup partial value while advancing early closure. However, without explicit linkages to labor and community outcomes, such mechanisms risk privileging financial interests at the expense of broader justice goals. One possible remedy is to earmark a portion of market-based revenues for community reinvestment, supporting job creation, energy access, or local infrastructure in affected areas. (Energy for Growth Hub, 2021)

Ultimately, the effectiveness of market-based incentives depends not only on their financial design but also on the integrity and alignment of their implementation with long-term equity objectives. Transparency in pricing, allocation, and governance will be essential to maintaining public trust.

Financial Mechanisms Supporting Coal Transition

Role of Development Finance Institutions (DFIs) in Coal Phase Out

One of the most critical yet often overlooked contributions of DFIs lies in their ability to absorb types of risk that private investors typically avoid, including transition risk, policy unpredictability, and currency volatility. This risk absorption becomes foundational to attracting commercial co-investment in

coal-heavy economies with weak carbon pricing and regulatory regimes. Such risk mitigation is particularly relevant for coal phase-out, where asset stranding, PPA renegotiation, and repayment uncertainty deter private capital. DFIs also function as trusted institutional intermediaries, facilitating funding and sectoral reforms. In South Africa, for instance, DFI engagement went beyond finance to include mandates for tariff rationalization, utility unbundling, and labor reskilling within the Just Energy Transition Partnership (JETP). Additionally, the structuring of blended finance deserves closer examination. While often praised, blended deals differ widely in execution. Some prioritize sovereign credit enhancements, while others subsidize first-loss tranches in special-purpose vehicles, raising questions about who ultimately benefits: public agencies, state utilities, or private investors. As Climate Bonds Initiative (2024) points out, the effectiveness of such blended structures in delivering coal retirement depends on the alignment of financial engineering with clearly articulated coal decommissioning strategies and timelines. (Kachi et al., 2024; World Bank, 2022)

There is also growing critique that DFI support can disproportionately focus on large-scale, grid-connected infrastructure while under-engaging with local financial institutions or community-based energy systems. Without deliberate social safeguards, DFI-backed projects may risk reinforcing centralized energy models that marginalize vulnerable regions. Another overlooked bottleneck is implementation capacity. Even when DFIs provide generous concessional finance, host countries may lack the institutional readiness, project pipelines, or procurement systems to utilize funds effectively, leading to low disbursement rates and missed opportunities. From a geopolitical lens, many DFIs, such as the World Bank or ADB, are historically Western-led. In DEVELOPING ASIAN countries, where Chinese concessional lending dominates, this can affect perceptions of neutrality or create parallel financing systems with different environmental standards. The rise of alternative institutions such as AIIB may shift the strategic terrain of coal transition finance. Lastly, DFIs are not

just financial actors but translators between international climate objectives and national development priorities. Therefore, their influence in shaping policy environments, defining “credible transition pathways,” and coordinating with multilateral frameworks such as Article 2.1c of the Paris Agreement cannot be understated. (Manych et al., 2024; Climate Bonds Initiative, 2023b; Kachi et al., 2024)

Blended Finance and Public-Private Partnerships (PPPs)

As mentioned in previous sections, blended finance and public-private partnerships (PPPs) have emerged as critical tools to de-risk climate investments and accelerate coal transition strategies. These mechanisms combine public concessional finance with private capital to attract broader investor participation, especially in high-risk markets. Bartosz (2024) illustrates how PPPs have successfully addressed regulatory instability and financial barriers in Poland’s renewable energy sector by blending public financial support with private sector expertise, particularly in emerging sectors such as offshore wind, solar, and green hydrogen production. These partnerships are credited with stabilizing policy frameworks and modernizing outdated grid infrastructure to accommodate renewables. However, the effectiveness of PPPs in the coal transition space hinges not only on capital flows but also on the distribution of risk and accountability. Without clear performance benchmarks and social safeguards, public contributions risk subsidizing private profits without delivering long-term climate or community outcomes.

In the context of Asia, Raghutla and Kolati (2023) examined the role of political cooperation in fostering PPP-driven renewable energy investments in China and India. Their study highlights how strong government support and coordination with private investors have contributed to higher investment and technology transfer levels, facilitating large-scale deployment of clean energy. Yet, such cooperation is often uneven across subnational jurisdictions, pointing

to the importance of decentralized governance models that can adapt PPP structures to local institutional capacities and energy needs.

Moreover, Koh and Khoo (2024) emphasize the growing importance of blended finance in transition finance (TF), citing its use in scaling early-stage clean technologies and enhancing resilience in emerging markets. Their findings suggest that blended finance structures, including green bonds and transition-linked instruments, can support smaller-scale public-private projects, such as solar microgrids, by spreading risks and making them palatable to institutional and philanthropic investors.

Importantly, these mechanisms allow public actors to “crowd in” private investment where market failures exist, especially in frontier sectors such as battery storage, grid-edge technologies, or rural energy access where conventional investors hesitate. However, for blended finance to deliver just outcomes, more transparency is needed in calculating concessionally, who benefits from derisking, and how local communities are involved in project selection. The success of PPPs and blended finance also depends on effective exit strategies for public support, ensuring that private actors gradually assume full financial responsibility once projects reach commercial viability. Without such strategies, there’s a risk of long-term market distortion or overreliance on public funds. These insights collectively affirm that PPPs and blended finance mechanisms are not just funding tools but foundational to enabling an inclusive and bankable coal phase-out. Ultimately, the value of these mechanisms lies not only in unlocking capital but in aligning that capital with transition goals that are socially equitable, technologically appropriate, and institutionally embedded.

National Transition Funds and Just Transition Financing

National governments have increasingly recognized the need to establish dedicated financial mechanisms to ensure a just and equitable energy

transition, especially in coal phase-outs. The 2023 Forum of the UNFCCC Standing Committee on Finance highlighted the importance of aligning national climate plans and long-term low-emission development strategies (LT-LEDS) with financing mechanisms prioritizing equity and inclusivity. These mechanisms often include Just Transition Funds (JTFs), public investment strategies, and policy frameworks to protect vulnerable communities and promote workforce reskilling. However, the effectiveness of such funds often hinges on their design, who governs them, who benefits, and how progress is measured. In many cases, decision-making remains centralized within finance or energy ministries, raising questions about whether community voices are sufficiently represented, especially from marginalized or informal worker groups. (UNFCCC, 2023c).

One notable example is the European Union's Just Transition Fund, which provides EUR 19.2 billion in grants to support carbon-intensive regions and industries as part of a broader EUR 55 billion Just Transition Mechanism. The Fund offers financial support for decarbonization and encourages social dialogue and inclusive governance at the regional level. Beyond its monetary scale, what sets the EU model apart is its structured monitoring and evaluation systems and spatial focus on regions experiencing multi-sector impacts from the coal transition. This highlights the importance of targeting direct coal hubs and secondary regions reliant on coal-powered industries. (European Commission, 2023)

In Japan, the Ministry of Economy, Trade and Industry (METI) has developed a national approach through its Japan Climate Transition Bond Framework. These government-labelled transition bonds are expected to mobilize 20 trillion yen in green transformation (GX) investments over the next decade, offering a pioneering example of sovereign-led transition finance. While the framework has strong sectoral alignment, it remains less explicit about how social equity outcomes such as employment transitions or rural revitalization will be achieved or measured. This points to a broader global challenge: how

to embed “just” objectives into financial instruments initially designed for infrastructure and emissions. (METI, 2023).

Similarly, the private sector has been increasingly engaged. For instance, Sumitomo Mitsui Financial Group (SMFG), a megabank, has implemented a Transition Finance Program that includes sustainability-linked loans and transition loans to support high-emission sectors aligning with long-term decarbonization pathways. However, questions remain about how these instruments balance climate integrity with financial returns. Mechanisms such as performance-based disbursement or local impact guarantees could offer greater assurance that funds support community-centered outcomes and not merely corporate transitions. Furthermore, timing is critical, as while many funds focus on post-retirement regeneration, few provide pre-closure support for workforce reskilling or community preparedness. This temporal mismatch risks creating social disruption before any financial support materializes. Policymakers must, therefore, consider staging finance to align with the lived transition timeline. (SMFG, 2023)

These multi-stakeholder efforts underscore the growing momentum for comprehensive, government-led transition financing strategies that mobilize private capital to support equitable coal transitions. Yet without transparent governance, inclusive stakeholder engagement, and context-specific metrics, national transition funds risk becoming symbolic rather than transformative. Their success will depend on how much they spend, who decides, who benefits, and how equity is embedded in every process step.

Enhancing Energy Security During Coal Retirement

As coal plants retire, ensuring energy security through grid stability, diversified energy sources, and equitable access becomes a critical policy objective. One key concern is the reliability of power grids during this transition. Solomon and Baldwin (2025) emphasize that clean energy systems are replacing outdated

fossil assets, but the shift may undermine grid reliability without modernizing grid infrastructure, including interconnection timelines and storage. Their report recommends combining clean energy additions with demand-side solutions and flexible technologies to balance variable renewable energy sources. Similarly, Kellow et al. (2018) underscore the dispatchability and resilience of coal and advocate for reforms that enable a smoother transition by supporting the grid's operational integrity. Moving forward, cleaner base-load alternatives are necessary to complement renewable energy. Mohammad et al. (2021) argue for the role of natural gas as a transitional energy source due to its relatively lower emissions and scalability. Hydropower, nuclear, and geothermal also offer low-carbon, steady supply options. Wu et al. (2024) show that for provinces such as Shandong, China's largest coal power producer, maintaining energy security during coal phase-out requires an optimized mix of renewables, storage, and cleaner base-load technologies.

In countries like Bangladesh and Pakistan, coal phase-out poses significant risks to energy security, particularly due to high dependency on imported fossil fuels and limited renewable integration. Both countries face affordability and accessibility challenges, which must be addressed alongside supply stability during the transition. Expanding renewables, especially solar and wind, can improve self-sufficiency and reduce vulnerability to fuel price volatility, but this requires urgent grid upgrades and supportive regulatory frameworks. (Akash et al., 2024; Asghar et al., 2023; Hossain et al., 2023; Amin et al., 2022c)

Beyond centralized energy solutions, decentralized and community-led models play a growing role. Wijayanto et al. (2025) demonstrate that Indonesia's 2050 vision includes integrating hydrogen and nuclear power while prioritizing distributed solutions such as mini-grids. Trueworthy et al. (2025) highlighted how community-driven design helps tailor renewable projects to local needs, building resilience while fostering inclusivity. Gil García et al. (2022) explore the concept of energy communities, where local groups co-own and co-manage renewable energy systems; this ensures energy access in rural

and underserved areas and democratizes the transition. Moreover, investing in grid flexibility and regional interconnections becomes paramount as more coal plants go offline. According to the World Bank (2024), modern grid planning must incorporate cross-border power trade and firm capacity investments to meet growing demand while balancing climate targets. Without such measures, coal retirement could risk energy shortages, especially in fast-growing economies with uneven renewable penetration.

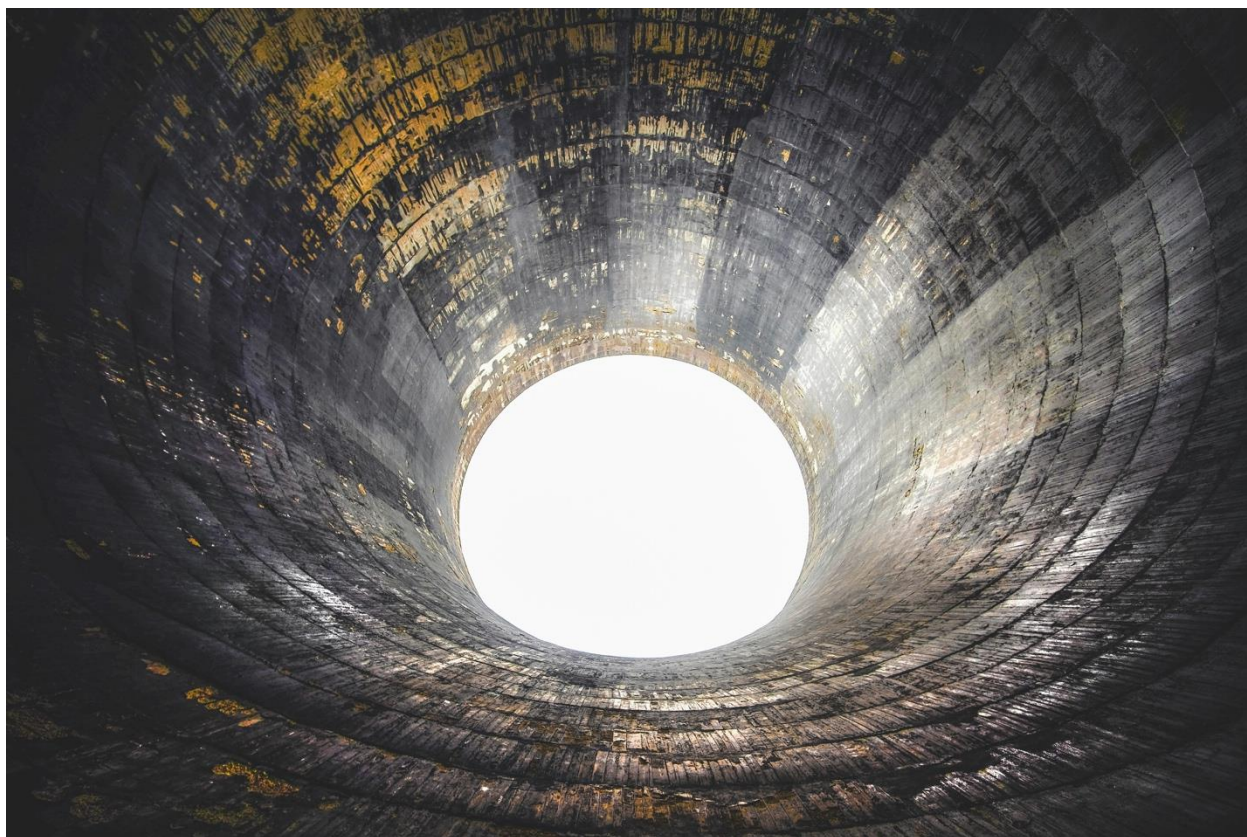
Recent studies show that in Pakistan, a balanced energy mix strategy combining indigenous resources with scaled-up renewables offers a practical solution for enhancing energy security without delaying coal retirement. Scenario modelling suggests that with proper long-term planning, countries in South Asia can reduce their reliance on coal while maintaining grid reliability and affordability. (Joyo et al., 2025)

Maintaining energy security during coal retirement involves a multi-pronged approach: grid modernization, clean firm energy integration, and community-led solutions. Case studies from South Africa, China, and Southeast Asia underscore that a successful transition requires technical upgrades and inclusive governance, ensuring reliable, affordable, and sustainable energy access.

Literature Gap

Existing literature provides essential insights into coal phase-out strategies but often remains high-level and fragmented. Few studies offer detailed, facility-level, implementation-focused analyses of how early coal retirement can be operationalized at the plant level, especially in developing Asian countries, where financing, ownership, and policy frameworks are highly complex. This study distinguishes itself by relying on facility-level data gathered directly through structured interviews with key stakeholders, including coal-fired power plant operators, commercial and development banks, and multilateral

financial institutions across multiple developing Asian nations. While transition finance and financing tools are widely discussed, their integration with concrete mechanisms such as PPA renegotiation, stranded asset management, and DFI engagement remains underexplored. Additionally, the interaction between national transition funds, private capital, and climate-aligned instruments is not well captured in existing research. This study addresses these gaps by combining financial, institutional, and regulatory analyses across selected case study countries, specifically focusing on the roles of plant owners and financiers. By grounding the research in firsthand stakeholder perspectives, the study provides practical and context-sensitive insights that are otherwise absent in the literature. This approach advances practical, context-sensitive solutions that bridge policy ambition with on-the-ground implementation, contributing new insights to the global conversation on coal transition.



Methodology

Research Design

This study employed a qualitative case study approach to identify and analyze the key economic, financial, social and policy barriers to the early retirement of CFPPs in selected developing Asian economies. The research focused on two core stakeholder groups that represent the supply and demand sides of coal transition finance:

- Financial institutions, including commercial banks, policy banks (public financial institutions), and multilateral development banks (MDBs), serve as capital providers and shape the financial viability of transition strategies.

- Coal-fired power plant operators, who experience firsthand the economic, financial policy, and social challenges associated with early retirement and retrofitting decisions.

Semi-structured interviews were conducted using stakeholder-specific questionnaires that included closed- and open-ended items. The study emphasizes in-depth qualitative analysis to derive insights into local financing challenges, regulatory gaps, and institutional readiness.

The country cases were selected purposively to reflect geographic, policy, and energy system diversity: Bangladesh, Pakistan, Indonesia, and Malaysia for plant operators, and Japan, China, and a multilateral development bank for financial institutions. This country selection enabled cross-case comparison of enabling and constraining factors in the coal transition across various regulatory and financial systems.

Questionnaire Development

Stakeholder-specific questionnaires were designed to capture the perspectives of the financial and energy sectors on coal transition financing: one targeted at financial institutions (commercial banks, policy banks, and MDBs) and the other at coal plant operators. The questionnaire structure was directly informed by critical gaps and themes identified in the literature, particularly concerning stranded asset risks, policy incentives, blended finance structures, and social challenges of transition (Do & Burke, 2024; Manych et al., 2024; Srivastav & Zaehring, 2024).

Each questionnaire was organized into modules that align with the major dimensions emphasized in the literature on early coal retirement:

- Financial and economic barriers
- Policy and regulatory frameworks
- Risk perception and bankability
- Transition finance mechanisms

- Social and operational challenges
- Energy security and infrastructure (for plant owners)
- International investment perspectives (for plant owners)

Closed-ended questions were designed to enable comparability across stakeholders and geographies. In contrast, open-ended questions were included to capture richer, country-specific insights into regulatory frameworks, financial innovation, and operational realities.

The mapping process ensured that each question was systematically aligned with a specific thematic area derived from the literature. For instance, questions on policy incentives (e.g., government-backed guarantees and regulatory reforms) are grounded in studies emphasizing the role of public intervention in de-risking coal transition projects (Climate Bonds Initiative, 2023a; Do & Burke, 2024). Similarly, recent research on transition financing and the challenges of refinancing coal assets informed the focus on financial risks and stranded assets (Nedopil et al., 2024; Manych et al., 2024).

The tables below summarize the linkage between questionnaire themes, specific questions, and the corresponding literature for each stakeholder group.

Table 1: Mapping Table for Bank Questionnaire

Theme	Question(s)	Literature Reference
Financial and Economic barriers	Q4, Q5, Q6, Q15	Climate Bonds Initiative (2023a); Gong & Lewis (2024)
Policy and Regulatory Frameworks	Q10, Q11, Q12	Do & Burke (2024); METI (2023)

Risk Perception and Bankability	Q4, Q5, Q6, Q9	Pandey & Kumar (2021); OECD (2024)
Transition Finance Mechanisms	Q7, Q8, Q9, Q23	Climate Bonds Initiative (2023b); Kachi et al. (2024)
Social and Operational Challenges	Q19, Q20	World Bank (2021b); UNFCCC (2023c)
Incentives and Enabling Factors	Q10, Q17, Q18	Climate Investment Funds (2024); Gong & Lewis (2024)

Reference: Developed by the authors

Table 2: Mapping Table for Plant Owner Questionnaire

Theme	Question(s)	Literature Reference
Financial and Economic Barriers	Q5, Q6, Q7, Q8, Q9	Ahmed et al. (2024); Manych et al. (2024)
Policy and Regulatory Frameworks	Q20, Q21, Q22	Do & Burke (2024); Chattopadhyay (2024)
Risk Perception and Bankability	Q1, Q2, Q6, Q9	Gong & Lewis (2024); OECD (2024)

Transition Finance Mechanisms	Q7, Q10, Q11, Q12	Climate Bonds Initiative (2023a); Kachi et al. (2024)
Social and Operational Challenges	Q18, Q19	Wu et al. (2024); Younas & Usmani (2024)
Energy Security and Infrastructure	Q15, Q16, Q17	Wu et al. (2024)
Role of international investment	Q23, Q24, Q25, Q26	Manych et al. (2024); Climate Bonds Initiative (2023b)

Reference: Developed by the authors

Sampling Strategy

The study targeted two primary stakeholder groups for data collection:

- Financial institutions, such as commercial banks, policy banks, and MDBs, play a critical role in structuring and delivering transition finance for coal retirement projects.
- Coal-fired power plant operators are directly responsible for managing early plant retirement and energy transition's operational, financial, and social implications.

Participants were selected based on their active involvement or strategic importance in coal phase-out efforts within the study countries. For financial institutions, target respondents included those with experience in transition finance instruments, exposure to coal-related assets, or strategic mandates

related to energy sector decarbonization. For plant operators, the focus was on owners and operators of medium- to large-scale coal-fired power plants, particularly those facing near-term regulatory, financial, or operational pressures to transition.

The selection criteria for plant operators were further considered:

- Plant characteristics, including installed capacity (typically greater than 100 MW), age of the plant, and remaining operational lifespan;
- Ownership structures, prioritizing a diversity of ownership models (public, private, or public-private partnerships) to capture different governance and financial incentive landscapes;
- Financing experience, particularly whether the operator has engaged with international financial institutions, blended finance mechanisms, or domestic green finance initiatives.

The study aimed to engage approximately two coal-fired power plant operators from each country: Pakistan, Bangladesh, Indonesia, and Malaysia. For financial institutions, the study sought key representatives from three categories: commercial banks, policy banks, and MDBs. Stratified purposive sampling was utilized to ensure representation across geographies, ownership models, and financing experiences.

Local senior researchers in each country were assisted in identifying and interviewing CFPPs and reviewing the government policies on coal phase-out. Due to sensitivities around coal phase-out strategies, outreach efforts emphasized confidentiality and voluntary participation.

Data Collection

Data collection for the study was conducted primarily through semi-structured interviews guided by stakeholder-specific questions developed for financial institutions and coal plant operators. To ensure contextual relevance and

facilitate access to target respondents, the surveys were implemented in close collaboration with field researchers in each country.

Questionnaires were distributed through a combination of methods, depending on the country context and stakeholder preference:

- Self-administered surveys distributed electronically (e.g., via email or secure online survey platforms).
- Structured interviews conducted online (e.g., Zoom or Teams) or in-person, where feasible, particularly for respondents requiring clarification or support.
- Assisted survey completion through Local senior researcher in each country for respondents with limited digital access.

Interview questions covered dimensions such as economic viability, financing options, regulatory frameworks, and social implications of early coal retirement. Based on respondent consent, interviews were audio-recorded or documented through detailed notes.

The sample included approximately two coal-fired power plant operators per country (Bangladesh, Pakistan, Indonesia, Malaysia), and selected representatives from commercial banks, policy banks, and MDBs. No statistical generalization is intended; the study prioritized depth and context-rich insights over breadth.

The data collection period spanned approximately one month to accommodate national holidays, local research partner schedules, and varying levels of respondent availability. A preliminary outreach phase was undertaken to secure participation and schedule interviews where necessary, followed by systematic questionnaire administration.

All respondents were informed about the voluntary nature of their participation, the confidentiality of their responses, and the purpose of the research. Where appropriate, anonymized data will protect sensitive institutional or operational information. Monitoring protocols were established to ensure data completeness and consistency across countries.

Data Analysis Methods

Given this research's qualitative case study design, data analysis was conducted using thematic analysis, following an inductive–deductive approach. To ensure systematic coding and traceability, all interview transcripts and researcher notes were imported into Taguette, an open-source qualitative data analysis tool (Rampin & Rampin, 2021). Taguette was selected for its accessibility, transparency, and reproducibility, and has been increasingly adopted in academic research to support structured thematic exploration of interview-based datasets (Dimmock, 2022; Hussein et al., 2024).

The analysis proceeded in two main stages:

1. Initial coding: Based on the questionnaire structure, pre-defined themes were applied. Interview excerpts were tagged under categories such as “decommissioning costs,” “sovereign risk,” “regulatory barriers,” and “financial incentives.” This stage ensured consistency between data collection instruments and analytical categories.
2. Cross-case and emergent coding: Codes were reviewed across country cases and stakeholder groups to identify recurring sub-themes and emerging patterns. For instance, the frequent co-occurrence of “loan repayment obligations” and “limited refinancing options” revealed a more profound concern among coal plant operators over stranded asset risks. Similarly, mentions of “grid instability” were repeatedly linked to perceptions of transition-related technical risk.

All themes were organized into broader analytical domains: financial risk, economic viability, policy constraints, institutional incentives, and transition financing mechanisms. Thematic frequency and code co-occurrence matrices were generated to assess which barriers were most salient across cases and to explore interrelations among topics (e.g., “carbon pricing” often co-appeared with “market risk” and “policy uncertainty”). Thematic analysis enabled the identification of both stakeholder-specific concerns and systemic cross-cutting challenges, enhancing the depth and practical relevance of findings.

To preserve the richness of qualitative insights, illustrative quotations were selected to support key findings and reflect the lived realities of diverse stakeholders. These quotations were anonymized and categorized by stakeholder type and country context to safeguard respondent confidentiality.

The final results presented a synthesized understanding of the main economic, financial, and institutional challenges hindering early coal retirement, as perceived by capital providers and asset operators in Asia's transitioning economies.

Empirical Study and Policy Implications



Economic and Financial Pathways for Accelerating Coal Power Plant Transition: Evidence from Bangladesh

Executive Summary (Bangladesh)

Bangladesh is at a turning point in its energy development trajectory. Natural gas, oil, and coal comprise more than 97% of the country's electricity generation mix. The nation is projected to reach an energy import dependence of 90% by 2041, with annual import costs crossing \$40 billion. Hence, the urgency to shift toward renewable energy is driven not only by ecological reasons but also by economic and strategic ones. In this context, transitioning from coal-based electricity generation to renewables is necessary for macroeconomic stability, energy security, and fiscal sustainability.

This study seeks to understand the financial and economic barriers as well as policy considerations for phasing out coal power plants in Bangladesh through a just transition framework. ~~This study seeks to understand the barriers,~~

opportunities, and policy considerations for phasing out coal power plants in Bangladesh through a just transition framework. To this end, Barapukuria and Rampal coal power plant owners have been interviewed, and they have shed light on stakeholder concerns, infrastructural limitations, and financial disincentives associated with early coal retirement. Asset devaluation, and the absence of workforce protection mechanisms have emerged as key concerns in transitioning from coal power plants. To be more specific, the lack of a time-bound and financially de-risked transition roadmap, depreciation costs and under-recovery of capital investments due to premature shutdowns of coal plants, infrastructure inadequacies—particularly outdated grid systems, unreliable storage capacity, as well as limited renewable integration mechanisms, and lastly, the human cost of transition, i.e., job losses, have transpired as key issues hampering a just transition.

Additionally, barriers include lost revenue from halted plant operations, and limited access to low-interest or green financing. Moreover, a lack of trust from financial institutions in renewable projects, long-term contractual obligations, and the need for stakeholder compensation further complicate the transition process.

Despite these obstacles, the study finds that the transition from coal is possible if coherent, inclusive, and forward-looking policies support it. To that end, based on the policy evaluations conducted and the findings, the study has made the following recommendations:

- **Strengthen Financial Mechanisms:** Deployment of concessional and blended finance, tax incentives, and risk mitigation tools by the government enables accelerated coal phase-out and attracts private investment in renewables and grid infrastructure.
- **Develop a Coherent Policy Framework:** A national energy strategy integrating emission targets, local equity, clear investment incentives,

unified data systems to enhance investor confidence, and energy access, while ensuring alignment across cross-sectoral policies (e.g., Delta Plan, Power System Master Plans).

- **Strengthen Institutional Capacity:** A dedicated national unit to coordinate international climate finance, manage fund inflows, as well as engage multilateral and bilateral donors can mobilize blended finance and lower investor risk.
- **Lead with Institutional Reform:** Placing SREDA under the Prime Minister's Office and establishing an independent energy commission can ensure accountable governance, supported by a centralized energy data system and regular policy reviews.
- **Accelerate Renewable Energy Deployment:** An accelerated rooftop solar, wind, and equipment manufacturing through storage investment, increased public funding, FiT and auction schemes, with SREDA leading a credible renewable roadmap.
- **Invest in Just Workforce Transition:** A Just Transition Fund, modeled on EU and ASEAN practices, to finance targeted training programs for coal workers, women, and youth in renewable energy technologies and support inclusive reskilling and job creation.

In conclusion, Bangladesh's future energy depends on the nation's ability to address its regulatory and financial issues. With proactive government action, international collaboration, and a commitment to inclusive planning, the country can make the difficult path of a just transition from coal power plants, which is both environmentally responsible and economically and socially achievable.

1. Introduction

Globalization and recent economic development have increased infrastructural development and industrialization, ultimately increasing energy use worldwide. According to Global Energy Review 2025, global energy demand increased by 2.2% in 2024, and emerging countries were responsible for over 80% of the growth. Most of these demanded energy resources are fossil fuels, which are responsible for the emission of CO₂ and other greenhouse gases, such as CH₄, CFC, CO, etc., into the environment.

According to Jafari et al. (2022) and Amin et al. (2022a), the largest amount of greenhouse gas emissions from human activities occurs when fossil fuels are burned for electricity, heat, and transportation. According to the World Nuclear Association (2024), around 40% of energy-related CO₂ emissions occur when fossil fuels are burned for electricity generation. Thus, decarbonising the electricity sector and shifting towards renewable resources will help lessen CO₂ emissions and ultimately reduce global warming.

Although many reform initiatives have been undertaken, concerns remain regarding Bangladesh's energy sector's slow adoption of renewable energy, limited exploration of domestic natural gas reserves, high reliance on imported oil, costly capacity charges, lack of cost-reflective pricing, energy inequality, and inconsistent policies. Over the last ten years, Bangladesh's electrical generation capacity has increased significantly, reaching over 28,000 MW in 2024. However, the country's reliance on fossil fuels has also made it more susceptible to climate change and increased its reliance on imports (Amin et al., 2022b).

The 2025 electricity generation statistics from the Bangladesh Power Development Board (BPDB) reveal that natural gas, including imported Liquefied Natural Gas (LNG), accounts for around 54.83% of the nation's electrical generation. Oil is in second place at 21.83%, followed by coal (20.45%) and renewable energy sources, including solar and hydropower (2.90%). Bangladesh imports nearly half of its fuel at present.

According to estimations from the Integrated Energy and Power Master Plan (IEPMP) 2023 and the Power Sector Master Plan (PSMP) 2016, the country may be 90% dependent on imported fuel by 2041, with an annual cost of at least \$40 billion for energy imports. The Global Carbon Project (2024) estimates that 29 million tonnes of CO₂ emissions will result from Bangladesh's coal usage.

The cost of imported energy also adds inflationary pressure. The recent depreciation of the Bangladeshi Taka has worsened the situation further. Despite reductions in energy prices, the international energy market remains highly volatile, with geopolitical risks continuing to pose challenges for Bangladesh.

The cost of producing electricity varies greatly based on the energy source. According to the most recent BPDB data, Bangladeshi Tk (BDT) costs 18–20 per kWh to produce electricity from oil, BDT 7 per kWh from coal, and BDT 3 per kWh from gas. According to 2025 Bloomberg's statistics, renewable energy production costs will drop to BDT 8–10 per kWh by 2030 from an estimated BDT 10.5 per kWh in 2024. The price scenario explains why, starting in late 2019, Bangladesh began concentrating on coal to meet the increasing demand. Before 2020, coal accounted for an average of 3% of electricity generation. Eight CFPPs with a combined installed capacity of 7179 MW are currently operating.

While Bangladesh recognizes the importance of expanding its renewable energy sector, progress remains slow. Although the government scrapped 10 coal-based power plants as a gesture to move towards renewable energy development, technical issues, including low-quality materials, inefficient battery use, and inadequate technical knowledge, are some of the examples that hinder the effectiveness of the initiative. On top of that, the absence of just transition policies and blueprints increases the institutional loopholes that impede the willingness of different stakeholders to engage in energy transition activities.

Consequently, Bangladesh's energy transition is a crucial factor in determining its economic resilience and national security, in addition to being an ecological need. However, fulfilling this shift requires significant resource allocation, strengthening institutional frameworks, and prompt implementation of policy reforms. Furthermore, a successful shift will require strong supply-chain management, technological adoption, political commitment, and cooperative interactions with international players and financial institutions. Implementing an open and inclusive process for updating and revising energy policies, strategic master plans, and pertinent laws is, therefore, clearly necessary.

Against this backdrop, this report aims to analyze and develop strategies for encouraging a just transition by phasing out coal power plants early. It also suggests policies to overcome the barriers with a collaboration of stakeholders, plant owners, and financial institutions in Bangladesh.

2. Local Survey and Data Collection

2.1 Interview Setup

After securing approval from the Ministry of Power, Energy and Mineral Resources, representatives from two major coal-fired power plants—Barapukuria coal power plant (installed capacity: 520 MW) and Rampal coal power plant (installed capacity: 1320 MW)—were interviewed. The Ministry informed the plant management teams and personnel of the survey to ensure the interviewees knew the study's purpose and availability window.

The questionnaires were structured and focused on barriers and incentives for early coal plant retirement. The interviews were conducted within thirty to forty-five minutes each, considering the plants' operational schedules. The interviewer provided the necessary clarifications where the interviewee had queries (regarding the questions). Besides, the interviewer encouraged respondents to elaborate on key points wherever applicable. As per government guidelines, no audio recordings or photographs were taken.

However, accurate notes were taken to preserve the depth and nuance of each response.

The survey's primary goal was to identify the challenges that plant owners face when they contemplate an earlier-than-planned retirement of coal-fired plants. Additionally, the goal was to gather practical insights into transitioning toward cleaner energy sources. The survey results have been critically analyzed to draw practical insights from plant-level experiences.

2.2 Data Collection Summary

2.2.1 Issues and Concerns with Early Retirement of Coal Power Plants

The plant owners showed few concerns about the transitioning process. They identified a number of risk factors for their power plants, such as increasing renewable power generation share, price competition from renewable sources, or declining profitability of coal operations for their desire in this transition process. Additionally, the plant owners emphasized the burden of external costs, such as environmental compliance costs, increasing the risk of production reduction.

The power plant owners mentioned certain challenges while transitioning from a coal-based power plant to the renewable sector, which is making this transition more difficult. Among all those issues, one of the foremost issues is the additional cost associated with the early retirement of a power plant, which burdens them.

At the same time, there will be a potential loss of the Internal Rate of Return (IRR) on continued operations that the firms are expected to get. Furthermore, the plant owners raised concerns about the shortage of technical skills and infrastructural constraints in Bangladesh's power sector and the grid. They claimed it would be extremely challenging to shift to any new sector without proper infrastructure and a skilled workforce. They elaborated that a skilled and

experienced workforce can work in the renewable sector more efficiently. Besides, the transition of the power plant may have a crucial impact on the local communities working here. Specifically, those workers who will face job placement may become unemployed for some time, making them susceptible to financial difficulties.

The plant owners stated that they would have to extensively consider the lifespan of coal power plants when considering the retirement of coal power plants. Usually, coal power plants have a lifespan between 40–50 years and 20–30 years (Edianto et al., 2023; Moazzem & Sadik, 2023). They will incur losses and waste resources if they go into the transition process where the shelf life remains. In addition to that, they will have to face depreciation costs.

Plant owners have expressed energy security concerns associated with retiring coal plants early. Coal is one of the most important resources for ensuring Bangladesh's energy security due to its availability, reliability, and role in maintaining a stable base-load power supply. In Bangladesh, the electricity generation from coal is far cheaper, and the production amount is higher to meet the demand of this large population. Therefore, the plant owners think coal is still more feasible in Bangladesh than renewable resources to meet the growing energy demand, and early retirement might lead to energy insecurity.

They further stated that Bangladesh lacks sufficient renewable energy sources to reliably meet demand. Solar is the only dominant source. Bangladesh has significant potential for solar energy due to its average solar radiation of 4–6.5 kWh/m² per day, which can help improve rural living standards and support broader economic development (Amin et al., 2021). However, limited land availability and difficulties in land acquisition are two major barriers to large-scale development.

Regarding how Bangladesh's energy infrastructure can be adapted to accommodate renewable energy from the closure of this coal plant, plant

owners stated that this adaptation would be feasible when improved renewable technologies offer electricity at lower prices. Further discussion indicated several specific infrastructure issues—insufficient grid capacity and limited energy storage. To address these issues, they suggested key steps, including grid modernization, energy storage investment, distributed renewable deployment, transmission expansion, and regulatory reform. Both plants have identified technology and infrastructure conditions as their major concerns. These concerns can be tackled by upgrading the grid and storage.

When queried about the infrastructure improvements (e.g., transmission lines and storage facilities) necessary to support the transition from coal to renewable energy, both owners pointed to weak transmission infrastructure as an obstacle to moving away from coal. Their responses reflect broader issues in Bangladesh's electricity network, i.e., voltage drops, energy loss outside Dhaka, and unreliable grid connections. Although expanded grid connectivity has increased access to electricity for the broader population, grid reliability has remained unaddressed. The prevailing grid infrastructure is still unreliable for large-scale renewable electricity transmission (such as solar), which the government should have continuously upgraded over the years (Amin et al., 2022d). Therefore, addressing these infrastructure gaps must be a top priority in national energy planning.

2.2.2 Economic and Financial Barriers

In-depth interviews revealed that if any power plant stops operating, the investors will suffer a loss as their investment cost will not be recouped. Thus, they will lose confidence collaborating on new projects with these power plants. Additionally, the power plant will incur a loss due to the decommissioning cost and lose revenue from its operations (Maamoun et al., 2020). Moreover, power plant owners highlighted that the plant would face operational and strategic losses, penalties, and long-term damage to supplier relationships due to shutting down supply chains.

At the same time, according to the interviews, due to the early retirement of power plants, the most significant financial barriers that the power plants will face include loss of investment return, as the plant will no longer be able to operate and regain its required profit or capital cost. The plant owners also emphasized that the equipment and infrastructure used for production will no longer be used and will be depreciated or devalued (Kefford et al., 2018). In that case, the stakeholders of these power plants may claim compensation or a penalty according to clauses that will create a fiscal burden on the owners (Nedopil et al., 2024).

On the other hand, in Bangladesh, renewable projects may face difficulties such as permission delays, land acquisition problems, financing difficulties, uncompetitive power bidding, currency fluctuations, and power market instability. Therefore, the plant owners highlighted that when they transition towards renewable energy-based power plants from fossil fuel-based power plants, they may face several challenges, such as difficulties in securing loans for renewable investment due to slower returns and uncertainties in revenue. They added that many financial institutions are unwilling to invest in renewable projects and prefer fossil fuel-based projects.

Furthermore, they may struggle to access low-interest or green financing as financial instruments such as green bonds and climate financing are not popular and available in Bangladesh. They also argued that there is a shortage of skills and infrastructure in our country that reduces investors' confidence in investing in renewable projects. On the other hand, potential investors, who are politically unconnected, find it risky to initiate any new projects due to syndicates (Amin et al., 2022e).

The interviews raised the concern of the plant owners that, to invest in renewable projects, they will need huge investments that can be accumulated from domestic and international investors. However, they sometimes face difficulties accessing international climate finance or green investment to

transition to renewable projects. The plant owners expressed concerns about their insufficient knowledge or awareness of available funding sources, mechanisms, or eligibility criteria, which are limiting their ability to pursue these opportunities. Additionally, a significant barrier these plant owners face is a high-risk perception by international investors, especially in developing countries such as Bangladesh, where political instability, regulatory uncertainty, or lack of project transparency prevents international investors from investing in these power plants (Rabbani and Tahsin, 2024).

Thus, according to the observation of these plant owners, these financial risks can be mitigated by government-backed guarantees if the owners want to transition from fossil fuel-based power plants to renewable resources. These securities reduce the investors' perceived risks for the repayment of investment money if the renewable project faces any losses. It also increases the investors' confidence and encourages potential investors to invest in renewable projects.

2.2.3 Incentives for Coal Plant Owners

Regarding financial incentives or subsidies that would encourage plants to transition from coal to renewable energy, the coal power plant reported two enablers: performance-based subsidies and low-interest loans or grants. An example of the former (subsidies) can be payments tied directly to renewable output, and the latter (loans/grants) would immediately lower cost barriers to enable infrastructure and overall capacity development. There is broad global recognition that government intervention is essential in building effective financial ecosystems supporting green business development while reducing regional economic disparities and alleviating poverty (Owen et al., 2018).

On incentivizing investors to fund the transition of the respective coal plant toward renewable energy, both respondents pointed to reduced risk through government-backed schemes. The returns on green projects may appear low, slow, or uncertain, creating an investment irreversibility problem. Government-

backed schemes may address this issue, bridging the gap between capital costs and expected returns. Existing literature proves numerous global, regional, and national initiatives have been taken to accelerate the transition from coal, particularly in developing countries. While these initiatives vary in focus, they are mutually reinforcing. They aim to mobilize private investment through public financing, strengthen policy frameworks and governance, build collaborative partnerships, and promote a socially just energy transition (Nedopil et al., 2022).

Prevailing literature indicated that without implementing carbon pricing, renewable energy policies could potentially fail to mitigate global warming (Bowen, 2021). Shadow carbon pricing can accelerate the transition from coal to renewables by reducing the economic viability of coal plants—particularly when it is translated into an actual financial charge—while simultaneously enhancing the relative appeal of clean alternatives such as solar and storage, even at low carbon price levels (Clark et al., 2023). When queried on the role of carbon markets or pricing in influencing the power plant owners' financial decision-making, carbon pricing instruments might help in the long run, but they are now less influential. This is because until a regulatory blueprint is formulated, current stakeholders cannot be swayed by carbon taxes or emissions trading.

On the availability of local or international investment funds suitable for financing the transition of coal plants to renewable energy, plant owners asserted that international and national funds could be channeled for the renewable energy transition. For instance, the Green Climate Fund (GCF), Climate Investment Funds (CIF), the Just Energy Transition Partnership (JETP), and interest from the Asian Development Bank (ADB). Regarding local funds, financing comes from blended finance models involving Bangladesh Infrastructure Finance Fund Limited. Nevertheless, there is a need for proper regulatory and policy frameworks to enable the smooth flow of funds.

2.2.4 Policy and Regulatory Barriers

On the matter of policy or regulatory barriers that should be addressed to make the transition from coal to renewable energy smoother for power plant owners, several issues were pointed out. For instance, the absence of a just transition policy for coal phase-out, rigid long-term PPAs limiting plant flexibility, weak incentives for large-scale renewable investments, grid capacity, access issues for renewable integration, and limited access to international climate finance due to regulatory hurdles. These, directly and indirectly, create challenges in reallocating its assets and workforce towards renewable energy development.

When questioned on specific policies that could accelerate the financial and operational readiness of the plants to transition to renewables, power plant owners referred to the Renewable Energy Policy. The first national renewable energy policy was adopted in 2008 (Amin et al., 2021). Unfortunately, Bangladesh spent almost two decades without a new renewable energy policy or an update to the adopted policy.

Power plant owners singled out the GCF as one of the most relevant external drivers regarding specific policies that could accelerate this plant's financial and operational readiness to transition to renewables. The GCF accredits IDCOL and could actively mobilize resources for both climate adaptation and mitigation, which is also discussed by Wimmer (2023).

2.2.5 Role of Foreign Investment and International Support

Starting any new project requires significant funding, and transitioning from a coal-based power plant to a renewable energy-based power plant is no exception. Since the plant owners have limited sources of funds and the amount is insufficient, foreign investment could play a crucial role in this situation (Soto, 2024). The plant owners claimed that foreign investors could support their plants by providing the necessary capital for early coal retirement and renewable energy deployment. They highlighted that these investments

will enable access to low-interest green financing from international institutions such as the ADB, GCF, and the World Bank. They added that foreign investments will support the smooth transition of human resources by providing training and ensuring the availability and development of alternative energy resources that will accelerate the transition towards sustainable energy sources.

Furthermore, the plant owners responded that GCF is one of the most relevant climate finance initiatives for this coal plant's transition, as it supports developing countries by mobilizing resources to adapt to climate change and mitigation measures (Kanak, 2020).

Therefore, to raise funds, foreign investors must be incentivized to support the early retirement of these coal-based plants. According to the feedback from interviews with plant owners, policy frameworks that ensure long-term stability and investment security can help to encourage foreign investors to invest in these power plants. Usually, renewable energy projects have a longer payback period. Thus, a stability policy ensures the required return on investment and mitigates risk (Wall et al., 2019).

In Bangladesh, power plants face many challenges while attracting foreign investments for energy transitions to renewable sectors. They stated that due to regulatory uncertainty and inconsistent policy frameworks, many investors feel insecure about investing in the renewable sector in Bangladesh. The plant owners voiced that political risk or instability is a major concern in Bangladesh, which is undermining confidence and making it difficult to secure foreign investment for coal-to-renewables transitions in Bangladesh.

Moreover, the plant owners further expressed their desire to learn more about financial incentives that help foreign plants shift from coal-based power plants to renewable energy sectors. These financial incentives include subsidies, tax incentives, and loans (Wall et al., 2019) to support the early retirement of coal

plants, following which the plant owners can shift towards sustainable energy sources.

3. Review of Government Policies

3.1 Policy Overview

The energy policies of Bangladesh, in the context of coal phase-out from the energy generation mix, are unclear. The PSMP 2016 emphasized coal as a major component of its energy strategy because of its potential for providing relatively affordable electricity compared to natural gas and LNG. As per the plan, high-quality coal reserves amount to approximately 3.3 billion tons domestically, with at least 1,168 million tons deemed immediately minable (MPEMR, 2016). Domestic coal production is expected to steadily increase and reach approximately 16.5 million tons annually by 2040. The plan prioritized expanding coal infrastructure, including establishing pilot operations in mines such as Barapukuria, Dighipara, and Phulbari. The PSMP 2016 reinforces coal as the core pillar of Bangladesh's long-term energy strategy. To this end, the plan highlights coal's role in achieving an "optimal energy mix" and acknowledging coal development's significant environmental and social impacts (e.g., groundwater depletion, community displacement, and land subsidence). However, coal plants have no direct transition roadmap or retirement strategy. The plan presented coal as a long-term solution rather than a fuel to phase out.

In the IEPMP 2023, although there are mentions of consumption phase-down from coal, the transition process and the retirement of existing coal-powered plants are not detailed. On the contrary, the share of coal in the energy mix is such as to increase as coal-fired power projects such as Matarbari and Patuakhali are expected to add capacities of 1200 to 1320 megawatts each (MPEMR, 2023). Additionally, the plan explored the feasibility of extracting domestic coal while discussing comprehensive studies for local mines and

environmental mitigation. Similar to the Power System Master Plan 2016, a direct roadmap for decommissioning existing coal-fired power facilities or ending reliance on coal is absent. Instead, the plan focuses on continued coal imports during the 2030s before a shift to ammonia co-firing from coal during the 2040s.

The Bangladesh Delta Plan (BDP) 2100 highlighted adaptation to climate changes but has not outlined strategies to reduce coal dependency. Moreover, the plan notes the inclusion of clean imported coal as part of a strategy to replace natural gas. The plan has no discussion of a coal phase-out or transition strategy. The plan did not report a layout of the mechanisms to facilitate the early retirement of coal power plants is absent (GED, 2018). Similarly, the Perspective Plan of Bangladesh 2021–2041 (PP 2041) acknowledges the environmental risks of coal and suggests using ultra-supercritical technology and carbon taxes to mitigate emissions. However, it does not necessarily provide any roadmap for completely phasing out coal from the production process. The plan has projected coal to make up 35% of the power generation mix by 2041, up from just 2.8% in 2019 (GED, 2020). The rationale behind such a projection is its relatively lower cost than LNG and oil.

3.2 Policy Evaluation

The Power System Master Plan 2016 explicitly stated that coal would remain a core component of Bangladesh's energy supply through 2041. While there are suggestions for considering renewable energy after determining an optimal mix of gas and coal, the plan excludes any precise strategy, timeline, or targets for the early retirement of coal plants or for integrating renewable energy. Moreover, the plan has acknowledged instances of groundwater contamination and community displacement, which identifies the environmental and social impacts of coal mining activities. Policy measures have insufficiently addressed these concerns, and so there is a need for policy improvements to transition toward sustainable renewable energy alternatives.

The IEPMP 2023 lacks an explicit coal phase-out plan. Although there is mention of decreasing coal consumption in power generation by the early 2040s, the plan projects a continuing reliance on coal. The plan focuses on measures such as ammonia co-firing, domestic coal extraction, and environmental feasibility studies instead of a detailed plan to reduce or end coal-based power generation. This has created loopholes regarding the early retirement of coal plants. While the plan has discussed mitigating coal's environmental impacts by acknowledging that economic and security considerations should carefully guide coal usage, it lacks a financial and operational path for transitioning from coal altogether.

BDP 2100 mentions a strategy of procuring clean imported coal in response to the rapid depletion of natural gas. Besides this, the plan extensively focuses on water resource management, climate adaptation, and disaster resilience. While the plan discusses environmental vulnerabilities and long-term sustainability, it lacks any detailed roadmap for reducing or retiring coal-based energy. Moreover, though the plan recognizes the urgent need for cleaner energy options, it proposes shifting dependence from natural gas and oil to coal due to its cost-effectiveness without addressing its environmental impacts or detailing any potential strategy for a future phase-out.

The PP 2021–2041 endorses using domestic and imported coal for power generation. The plan does not discuss any measures for phasing out coal from the generation mix. On the contrary, it focuses on expanding the coal share in the future due to its cost-effectiveness and domestic resource availability. Although the plan mentions a 'policy debacle' of not having a comprehensive coal policy that has halted the extraction of domestic coal as well as environmental concerns, it primarily suggests adopting ultra-supercritical technology and phased development of coal fields instead of outlining any procedure or incentives for the retirement of existing coal plants. Additionally, though renewables are stated as a future priority, the plan does not have a concise framework for the approach to displace coal. It does not illustrate how

policy measures (e.g., a carbon tax) might effectively discourage coal usage. Hence, there is no mechanism for "early retirement" of coal power plants in the PP 2021–2041.

4 Key Takeaways

4.1 Lack of Financial Mechanisms for Transition from Coal to Renewables

Financial mechanisms are lacking to support renewable energy and transition investments. Power plant owners have expressed concerns over the absence of tailored fiscal and monetary incentives and government-backed financial mechanisms. The absence of innovative and de-risking financing instruments hinders investment in grid upgrades, storage solutions, and RE deployment, particularly in countries with weaker financial markets.

The rapid shift from carbon-intensive to low-carbon energy systems presents substantial financial challenges. High upfront capital costs and structural financing obstacles further complicate the transition, especially in developing economies with limited access to affordable financing. Renewable energy investments effectively de-risk projects by lowering costs and encouraging low-carbon development. In this context, the absence of such mechanisms in Bangladesh limits the country's ability to finance early coal plant retirements. It restricts the scale and pace of its clean energy expansion.

4.2 No Proper Policy Framework for Transition from Coal in Bangladesh

A viable option for transitioning away from coal is facilitating the development of renewable energy. However, Bangladesh's renewable energy policy landscape is outdated, fragmented, and inadequate to support a just transition away from coal. Although the National Renewable Energy Policy was adopted in 2008, no significant updates or strategic revisions have been implemented in over two decades. As a result, current policies are insufficient

to address a low-carbon transition, especially one that demands both socioeconomic justice and energy security.

The PSMPs, the IEPMP, and the Delta Plan are misaligned. These plans often contradict renewable energy goals and fuel use assumptions. These inconsistencies indicate a lack of coherent long-term vision and an absence of inter-agency coordination.

Moreover, there is no time-bound national roadmap to guide Bangladesh's energy transition while ensuring affordability and quality. Existing documents have not integrated disaggregated planning at the district or regional level, leaving behind vulnerable and marginalized populations who are most exposed to the adverse effects of climate change and energy poverty. Socioeconomic dimensions—such as employment displacement, income impacts, and gender equity—are largely absent in policy narratives.

While the Sustainable and Renewable Energy Development Authority (SREDA) has recently begun revising the 2008 renewable energy policy, the current draft policy 2022 remains inadequate. The draft lacks clarity on environmental protection standards and emission reduction strategies. For instance, just such as the Renewable Energy Policy 2008, the draft policy does not discuss the potential optimal renewable energy mix by analyzing the renewable energy diversification for Bangladesh. Furthermore, there is no discussion on investment framework, import tax issues, and FiT (Feed in Tariff) schemes, which are highly important for renewable energy transition. These shortcomings continue to deter domestic and international private investment in Bangladesh's renewable energy sector.

Furthermore, unreliable data and contradictory reporting across government agencies have severely limited evidence-based policymaking. Despite repeated calls from experts for comprehensive feasibility assessments and

resource mapping, this governance gap has impeded the country's ability to evaluate the feasibility and financial viability of projects such as wind energy.

Ultimately, the country's inability to modernize and align its energy policies has stalled renewable energy development and left the social dimensions of the energy transition—such as equity, inclusion, and regional parity—largely unaddressed.

4.3 Difficulty in Attracting Foreign Finance

A comprehensive and credible policy framework that encourages local and foreign investment remains missing. The energy transition process demands large-scale capital—such as the \$150 billion and €620 billion annual requirements projected for ASEAN and the European Union (EU), respectively (Zarim & Sastry, 2024; European Urban Initiative, 2024). Bangladesh, however, has not yet established an institutional infrastructure capable of facilitating foreign financing. The absence of a dedicated national body to manage external funds, build bilateral relationships, and streamline foreign investment processes results in lost opportunities for securing climate finance from sources such as the GCF, China-backed initiatives, or other bilateral and multilateral development partners.

Moreover, institutional integrity, regulatory stability, and inter-ministerial coordination—key prerequisites for foreign investor confidence—are perceived to be weak or inconsistent. There is no unified or strategic policy document that clarifies investment incentives, renewable energy project pipelines, or cross-border financial arrangements. Without such a framework, prevailing market barriers remain unaddressed, and Bangladesh's renewable energy sector continues to lag behind its regional counterparts in attracting capital. Public investment alone cannot meet the financing needs of large-scale energy infrastructure. Therefore, the lack of targeted policy direction limits foreign capital inflows and private sector participation.

4.4 Unclear and Inconsistent Role of the Government

Policy inconsistency and institutional weakness continue to hinder Bangladesh's energy transition. The government has yet to establish a formal, coordinated mechanism to regularly revise energy policies in line with emerging challenges and the evolving renewable energy landscape. Key institutions, such as the SREDA, remain under-resourced and lack the operational, financial, and legal capacity to lead the transition effectively. SREDA also does not enjoy the political authority needed to coordinate inter-ministerial efforts or oversee national energy planning, limiting its ability to make systemic change.

Furthermore, no independent energy commission can ensure transparency, accountability, or equitable stakeholder representation in energy decision-making processes. The absence of such a body leaves a critical gap in regulatory oversight. The absence of a national data bank or integrated platform for energy sector data impedes transparency and evidence-based planning.

4.5 Slow Progress of Renewable Energy Development

Despite several national plans, renewable energy adoption in Bangladesh remains at just around 3% of the total energy mix. The first and only National Renewable Energy Policy was adopted in 2008, and despite being outdated, it went largely unreviewed for more than two decades. Although the Power PSMPs and the more recent IEPMP referenced renewable development, they lacked specificity and failed to demonstrate clear pathways to reach targets.

Additionally, there have been low annual budgetary allocations for renewable energy—only around 5–6% of the ADP budget between 2015 and 2020, compared to 95–94% for fossil energy. SREDA, the key agency for renewable energy development, received a mere USD 0.73 million on average during that same period. Moreover, the draft revision of the renewable energy policy 2022

has not adequately addressed core issues such as ideal renewable energy mix or competitive pricing models. These omissions highlight a lack of institutional clarity and investment framework necessary for scaling up the sector.

Technical barriers—such as poor-quality equipment, inefficient battery storage, and low technical literacy—affect program effectiveness. Additionally, socioeconomic constraints such as lack of credit mechanisms, high upfront costs, and limited public-private collaboration further restrict adoption.

Moreover, the government has not clarified the transition pathway from coal to alternative sources. The renewable sector remains underdeveloped relative to the required scale of transition. Critical areas such as rooftop solar deployment, wind energy expansion, and domestic equipment manufacturing are still underdeveloped and unsupported by comprehensive policy direction.

4.6 Human Resource Displacement due to Coal Plant Shutdowns

The transition strategies of Bangladesh have yet to adequately address potential labor market disruptions resulting from the retirement of coal-fired power plants. Workers face long-term uncertainty without clear pathways for reskilling, redeployment, or alternative employment. The effects extend beyond coal industries alone, impacting non-coal sectors indirectly linked to the coal economy, including logistics, supply chains, and local services. However, the managerial and institutional perspectives necessary to manage these falling employment effects, primarily through renewable energy integration, are absent from national planning.

Bangladesh lacks a dedicated policy or investment framework that considers the socioeconomic fallout of the early retirement of coal assets. Prior literature rarely addresses financial components such as abandonment value, IRR, equity and loan repayment, regular operational maintenance cost, salvage value, and environmental costs (Moazzem & Sadik, 2023). Moreover, capacity-building activities targeting affected workers, women, and local stakeholders

are not institutionalized, and no nationwide effort exists to develop technical skills aligned with the demands of low-carbon sectors.

5 Policy Suggestions

5.1 Strengthen Financial Mechanisms to Support Transition

To overcome the investment gap in Bangladesh, the government must design and implement financial instruments tailored for renewable energy and just transition pathways. This includes concessional finance schemes, risk mitigation facilities, blended finance models, and tax incentives to encourage investments. Government-backed support should be extended to the early retirement of coal plants and the development of grid infrastructure and storage systems to attract long-term capital.

Given the absence of structured financial mechanisms for renewable energy development in Bangladesh, as identified by power plant owners and sector experts, the government must act quickly to establish fiscal and monetary incentives that de-risk investments and make them commercially viable. Strengthening financial strategies is essential to funding low-carbon infrastructure in the country. Without robust financial mechanisms backed by government commitment, Bangladesh will continue to fall behind in collecting and utilizing the scale of capital required for a just and effective transition from coal to renewable energy.

5.2 Establish a Comprehensive and Inclusive Policy Framework for Just Transition

A robust, time-bound, and inclusive national energy strategy must be developed to align with climate goals while addressing socioeconomic implications. A new renewable energy policy explicitly defining the ideal energy mix includes district-level implementation pathways. It outlines plans for emissions reduction, equity, and energy access needs to be established.

Ministries must collaborate, and alignment of national policies (e.g., Delta Plan, PSMPs) should be institutionalized to resolve contradictions and improve governance.

In addition, the updated policy must incorporate a clearly defined transition roadmap that balances energy security, affordability, and sustainability. This includes ensuring socioeconomic safeguards to protect vulnerable communities through disaggregated district- and division-level planning. The policy must go beyond the generic energy transition vision and establish mechanisms for resource diversification, environmental protection, and grid reliability.

Existing policies lack investment frameworks, FiT mechanisms, and import duty structures. A comprehensive study is also needed to assess the feasibility, resource availability, and financing options for alternative energy sources such as wind power, which remain underutilized in national strategies. Lastly, consistent and unified data reporting across government institutions should be mandated to minimize planning inconsistencies and enhance investor confidence in the transition agenda.

5.3 Develop Institutional Capacity to Attract Foreign Finance

A dedicated national unit should coordinate foreign finance, engage with multilateral climate funds (e.g., the Green Climate Fund), and build strategic bilateral partnerships with countries such as China and other financiers. This unit must have the technical and legal capacity to oversee incoming funds and ensure institutional integrity in all related processes. Without a clear policy framework, foreign finance opportunities remain underutilized.

A coherent and investor-friendly national policy document is essential to encourage local and international investments in renewable energy and grid modernization. Clean energy transitions are capital-intensive, so public funding alone is insufficient. Therefore, a robust institutional setup is necessary

to mobilize blended finance, reduce transaction costs, and address prevailing market barriers that currently deter private investors. The dedicated national unit would facilitate fund access and promote Bangladesh as a credible, climate-responsible investment destination.

5.4 Enhance Government Accountability and Institutional Reform

The government must lead the transition through proactive institutional reforms. SREDA's mandate should be upgraded, placing it directly under the Prime Minister's Office, with a leadership structure led by a senior secretary, and it should be equipped with adequate financial, legal, and operational capacity to drive the renewable energy agenda forward. Additionally, the establishment of a dedicated independent energy commission is essential. This body should include a diverse mix of energy experts, economists, legal professionals, private sector representatives, and civil society actors to ensure transparent and inclusive decision-making. The government must also create a comprehensive policy document encouraging local and foreign investments. Moreover, a centralized national energy sector data bank should ensure consistent and accountable data collection and dissemination. In order to maintain momentum, the government must implement a system for mandatory, periodic review of energy policies. The public sector should be positioned to play a significant role by initiating these institutional reforms and setting the standard for coordination, reliability, and long-term commitment to a just and sustainable energy future.

5.5 Accelerate Renewable Energy Development through Integrated Actions

The government should prioritize rooftop solar deployment, incentivize wind power, and support domestic renewable energy equipment manufacturing. Investment frameworks must address critical gaps in storage technologies, import tariffs, and after-sales service infrastructure to scale up successful initiatives. Besides, ADP allocations for RE must be significantly increased, and

FiT schemes and auction mechanisms should be introduced to attract new developers and private capital.

On the other hand, SREDA should be mandated to develop a comprehensive and time-bound roadmap for renewable energy deployment, ensuring realistic medium-term targets, diversified energy sources, and accountability in implementation. In parallel, institutional and socioeconomic barriers—such as limited credit access, high upfront prices, and lack of public-private collaboration—must be actively addressed. Technical deficiencies, including poor-quality materials and insufficient local expertise in battery storage and system maintenance, must be overcome through targeted training programs, quality control, and knowledge transfer.

5.6 Implement Workforce Transition and Skills Development Programs

Capacity-building programs must target displaced workers, women, and youth with solar, wind, and energy efficiency technologies training. Evidence from the EU suggests that while the energy transition may eliminate up to six million jobs by 2050, it could also create 11 million new ones, resulting in a net gain of five million jobs (Cavina et al., 2023). Drawing from this, Bangladesh must ensure that workers are not forced into unemployment. The government can adapt global best practices following the EU and ASEAN to formulate inclusive workforce transition strategies.

The Just Transition Fund, introduced to ensure that all regions benefit from the energy transition, will allocate an additional EUR 25 billion across the EU to support skill development and economic diversification (European Urban Initiative, 2024). Similarly, to address potential job losses from coal plant retirements, a Just Transition Fund may be established to finance worker reskilling and local job creation. Additionally, specific training initiatives should be designed in collaboration with industry stakeholders and target technical and managerial staff, preparing them for roles in renewable sectors. Moreover,

there should be customized programs to support transitions from related non-coal industries that may be indirectly affected. Bangladesh can also use the ASEAN as an example to develop a framework to recognize the need for targeted reskilling to match displaced workers with new low-carbon economic activities (ASEAN Centre for Energy, 2023).

6. Conclusion

The necessity of energy transition for Bangladesh is ecological, economic, and strategic. The country's heavy reliance on fossil fuels makes it vulnerable to climate change while imposing significant economic burdens through rising import bills, price volatility, and external shocks. Hence, a shift to renewable energy is essential for ensuring national energy security, macroeconomic stability, and sustainable development. However, financial, infrastructural, institutional, and policy barriers hinder transition, specifically from coal.

The insights from plant-level surveys on transitioning from coal revealed that power plant owners are concerned about financial disincentives, infrastructure deficits, and regulatory uncertainties. Additionally, they pointed out the significant risks associated with the early retirement of the coal power plants—transmission capacity, grid reliability, and energy storage—which currently limit the feasibility of large-scale renewable deployment. Moreover, they have highlighted the issue of human cost, i.e., job displacement and the lack of clear workforce transition pathways. Furthermore, lacking a functional, time-bound national roadmap for retiring power plants can cause investment in renewable alternatives to fall.

However, despite these challenges, the study finds that a just transition is achievable and economically wise, assuming that the government reforms existing policies. A comprehensive national transition strategy that includes concessional finance schemes, government-backed risk mitigation facilities, and aligning renewable energy policies with an economic development plan

is necessary. Additionally, an updated renewable energy policy, equipped with investment frameworks and emission-reduction targets, must be institutionalized alongside mechanisms such as FiTs and blended finance platforms.

Moreover, government partnerships with local and foreign investors and international climate finance entities such as the GCFs are required for a successful transition. Furthermore, a dedicated national unit for foreign investment coordination strengthened authority within government agencies such as SREDA, and establishing an independent energy commission is imperative to enhance investor confidence, promote accountability, and overall policy coherence. The government may also create a Just Transition Fund for skills development, reskilling programs, and job placement services to anticipate and manage the socioeconomic implications of coal plant retirement.

The transition from coal to renewable energy requires technological and financial preparation, political will, and institutional readiness. While there are multiple challenges, there are also many opportunities. Bangladesh can shift towards a low-carbon, economically resilient, socially equitable, and environmentally sustainable future if there is a strategic, inclusive, and evidence-based approach grounded in stakeholder input and international collaboration. Transitioning from coal is feasible if pursued with foresight, urgency, and collective commitment.



Economic and Financial Pathways for Accelerating Coal Power Plant Transition: Evidence from Indonesia

Executive Summary

Indonesia is committed to reducing carbon emissions in the power generation sector. The launch of the Just Energy Transition Partnership (JETP) is an important instrument for mobilizing funding, including for the early retirement of CFPPs and the development of renewable energy. However, early coal retirement is neither a simple nor an easy undertaking, particularly for Indonesia, which still maintains two policies: electricity subsidies and the Domestic Market Obligation (DMO) policy to stabilize electricity tariff. These two policies can pose significant barriers to energy transition. In this context, allowing coal fired power plants (CFPPs) to retire naturally, halting the construction of new CFPPs, and simultaneously accelerating the development

of renewable energy may be more pragmatic. One of the key obstacles to early retirement of CFPPs is the government's expectation that electricity prices remain stable, supply remains secure, and no additional burden is placed on the state budget. These expectations, coupled with the continuation of electricity subsidies and DMO policies, act as anchors that can further hinder the energy transition. Against this backdrop, it is essential to develop a supportive policy ecosystem that enables early retirement through market mechanisms and favors the growth of renewable energy (RE). Similarly, the implementation of carbon pricing, carbon markets, and green financing mechanisms is necessary to open greater opportunities for RE development and energy efficiency initiatives. Drawing on two case studies—Indonesia Power and Alamtri, this study provides a new perspective that in the difficult conditions of early coal retirement, pragmatic steps are still wide open to overcome economic and financing obstacles. Indonesia should prioritize the development of renewable energy power plants and systematically retire coal-fired plants with zero book value, low capacity and utilisation rate with a just transition process. The government must also work to establish an ecosystem that supports early CFPPs retirement and renewable energy by implementing carbon taxes, operationalizing carbon markets, and phasing out subsidies and DMO policies that artificially lower the cost of coal-based electricity.

1. Introduction

To meet the emission reduction targets of the Paris Agreement, global coal usage must decline by 80% below 2010 levels before 2030 (Paul Bodnar et al., 2020). Global data reveals two critical observations (IEA, 2024). First, fossil fuels continue to account for 81% of the total energy supply (TES) worldwide, with oil comprising nearly 30%, followed by coal (28%) and natural gas (23%). Second, global emissions from fuel combustion are dominated by coal (45%), followed by oil (33%) and natural gas (22%). In the context of global CO₂ emissions from fuel combustion by sector, the power generation sector remains the largest

contributor, accounting for approximately 43.8% (14.9 million ktCO₂) (IEA, 2024). Nevertheless, global trends indicate that an increasing number of CFPPs are becoming economically uncompetitive. Replacing these plants would yield not only economic benefits but also social and environmental advantages (Paul Bodnar et al., 2020).

In Indonesia, between 2000 and 2022, the power sector's contribution to carbon emissions from fossil fuel combustion increased significantly, rising from around 24% to approximately 45.5% (IEA, 2024). This trend has prompted the government to promote low-carbon development through several key regulations, including: (i) Presidential Regulation No. 61/2011 on the National Action Plan for Greenhouse Gas Emission Reduction; (ii) The Enhanced Nationally Determined Contribution (NDC), where Indonesia raised its emission reduction targets from 29% to 31.89% unconditional target and from 41% to 43.2% conditional target (National Statement of Republic of Indonesia, 2022); (iii) Presidential Regulation No. 112/2022 on the Acceleration of Renewable Energy Development for Electricity Supply, which outlines policies for the early retirement of coal-fired power plants; and (iv) The launch of the Just Energy Transition Partnership (JETP Indonesia) on 16 November 2022 during the G20 Summit in Bali, in collaboration with the International Partners Group (IPG).

As stipulated in the Regulation of the Minister of Energy and Mineral Resources No. 10 of 2025 concerning the *Roadmap for Energy Transition in the Power Sector*, the energy transition in the electricity sector is to be carried out through nine measures, namely: (1) implementation of biomass co-firing in coal-fired power plants (PLTU); (2) acceleration of the reduction in fuel oil use in power generation; (3) retrofitting of fossil-fuel power plants; (4) limitation on the addition of new coal-fired power plants; (5) acceleration of variable renewable energy (VRE) development and additional power generation exclusively from new and renewable energy sources; (6) production of green hydrogen (H₂) or green ammonia (NH₃); (7) development of nuclear power plants; (8) development and/or capacity enhancement of the power system network and

smart grid infrastructure; and/or (9) acceleration of the termination of operational periods for coal-fired power plants.

IESR estimates that the cost of early retirement of PLTU will reach US\$4.6 billion by 2030 and US\$27.5 billion until 2050 (Hidayatullah, 2025). Around two-thirds or US\$18.3 billion will come from privately owned CFPPs while the rest or US\$9.2 billion will come from PLN-owned PLTUs. In terms of loan guarantees, the position of PLN-owned PLTUs is more advantageous than privately owned CFPPs. The JETP Indonesia Secretariat noted three targets in the electricity sector in the joint statement, namely (JETP Secretariat - Indonesia, 2025):

1. Achieve total electricity sector emissions peak at an absolute value of no more than 290 MTCO₂ in 2030 (down from the 2030 baseline of 357 MTCO₂) and immediate decline as it shifts the projected emissions peak into the future.
2. Accelerating the deployment of renewable energy so that renewable energy generation comprises at least 34% of all power generation by 2030, roughly doubling total renewables deployment over this decade compared to current plans.
3. Mobilizing USD 20 billion in public and private financing in order to decarbonize Indonesia's energy sector, of which USD 10 billion will be mobilized by the IPG members and the other USD 10 billion will be facilitated by GFANZ for private finance.

Regarding the JETP initiative, the Indonesian government and the Asian Development Bank (ADB) signed a Memorandum of Understanding (MoU) to jointly study the accelerated retirement of the first privately owned (independent power producer/IPP) coal plant under ADB's Energy Transition Mechanism (ETM) (ADB, 2022). The MoU initiates detailed discussions to advance the early decommissioning of Cirebon-1 (by seven years, from the original 2035 schedule) (Eco-Business, 2025), a 660 MW power plant owned by Cirebon Electric Power (CEP) in West Java (Prominer, 2025). This planned

transaction aims to achieve substantial CO₂ emission reductions through a replicable model applicable to other IPPs in Indonesia, the Asia-Pacific region, and beyond. Upon reaching a definitive agreement, ADB is expected to provide senior debt financing for the early retirement, contingent on shortening the PPA tenure between CEP and PLN (Indonesia's state electricity company).

Furthermore, PT Sarana Multi Infrastruktur (SMI) has been appointed as the Country Platform for the Energy Transition Mechanism, serving as an early retirement funding mechanism for CFPPs and renewable energy financing. Current conditions show that Indonesia has as many as 178 CFPPs (excluding captive power), of which 129 units are owned by PLN and 49 units are owned by Independent Power Producers (IPP). Until 2045, carbon emissions from CFPPs will still occur, but the amount will be decreasing and will reach zero in 2050.

However, implementing early coal plant retirements is challenging due to multiple factors, including grid stability, energy security, equity concerns, stakeholder collaboration, and the availability of incentives and funding (Ekonomi Hijau, 2024). Currently, the government has taken a cautious stance, refraining from committing to early CFPP retirements (Business Insight, 2025). Minister of Energy and Mineral Resources (ESDM) Bahlil Lahadalia has stated that retiring coal plants is difficult to realize due to a lack of financing (Prominer, 2025). He outlined two prerequisites for early retirement (CNN Indonesia, 2025); First, Investor involvement to avoid burdening state finances, PLN, or the public; and second is the availability of replacement power generation capacity.

An important aspect to examine is the planned early retirement of Cirebon-1 from a stakeholder perspective. At least five key issues must be considered (Eco-Business, 2025); first, potential job losses in the coal sector, particularly for local workers with low skills, who face significant vulnerabilities without upskilling/reskilling programs. Second, environmental damage and land rehabilitation resulting from the plant's operations. Third, negative health impacts on nearby communities, including reduced productivity and harm to

local fishermen. Fourth, lack of transparent communication regarding the early retirement process; and finally, the absence of a clear roadmap for the transition. On the other hand, JEPT Indonesia pointed out that per dollar of investment, renewable energy creates three times more jobs than fossil fuels. Then, under the JETP investment plan, roughly 383,000 additional jobs for Indonesians would be created between 2023 and 2023. JETP Secretariat, assisted by four Working Groups and in close collaboration with the GOI and PLN, developed the Comprehensive Investment and Policy Plan (CIPP) based on technical modeling and public consultations.

However, a study from LPEM (2025) pointed that an early net zero emissions (NZE) might lead to higher prices, impacting household welfare. NZE scenarios will result in a slower decline in the poverty rate compared to the reference scenario, with a short-term increase in the poverty rate. Households with disabled member(s) will also experience a slower decline in the poverty rate, remaining the poorest group among others. NZE scenarios will also slow the decline in Gini ratio, particularly for female-headed households. The more ambitious the NZE target, the worse the impact on poverty rates and inequality will be. These results underscore the importance of government intervention to support vulnerability group through fiscal policy. The fiscal stimulus has proven to lower the poverty rate and Gini ratio in all of the groups. The desirable outcome can only be achieved through a committed institution that: (1) effectively implements carbon pricing, and (2) is dedicated to revenue recycling.

This paper aims to understand the perspective macro-micro context of the early retirement plans of CFPPs from the following six aspects: (i) economic and Financial Barrier; (i) Incentives for Coal Plant Owner; (iii) Energy Security and Infrastructure; (iv) Social and Workforce; (v) Policy and Regulatory Barriers; dan (vi) Role of Foreign investment and international support.

2. Methodology

This study uses a qualitative approach. Primary data collection is carried out using in-depth interview techniques. Structured in-depth interviews were conducted with two companies: PT Indonesia Power (a subsidiary of the state-owned electricity company, PLN) and PT Alamtri Power Indonesia (an Independent Power Producer / IPP). The selection of the two companies was done purposively by representing the business ownership side (government and private); having CFPPs and also developing renewable energy; and the age of the coal-fired power plants.

The interview with Indonesia Power focused on the Suralaya coal-fired power plant units 1–4, which began operations in 1984 with two units, each having a capacity of 400 MW. The second phase commenced in 1989, adding two more units with the same capacity. The discussion with PT Alamtri Power Indonesia centered on the Tanjung Power Indonesia (TPI) coal-fired power plant. PT Alamtri, in partnership with Korea East-West Power Co., Ltd., formed a consortium with ownership stakes of 65% and 35%, respectively. On August 12, 2013, the consortium established TPI to build, own, operate, and transfer a steam-powered power plant in South Kalimantan. Subsequently, on October 15, 2014, TPI and PLN signed a long-term Power Purchase and Transfer Agreement (PPTL). This agreement includes, among other components, the engineering, construction, ownership, and operation of a 2×100 MW coal-fired power plant in South Kalimantan Province (referred to as the South Kalimantan Power Plant / SKPP) and the provision of electricity to PLN over a 25-year period. The plant reached its Commercial Operation Date (COD) in August 2020. The discussion points in the in-depth interview were directed toward six issues of early retirement, namely: (1) examining economic and financial barriers; (2) incentives for coal plant owners; (3) energy security and infrastructure; (4) social and workforce impacts; (5) policy and regulatory barriers; and (6) the role of foreign investment and international support.

3. Review of Current Government Policies on Early CFPPs Retirement

Table 1 shows the regulations that are already in place regarding early retirement of CFPPs and the regulations that are still needed to implement this policy. Presidential Regulation No. 112 of 2022 (hereafter referred to as PR 112/2022) on the Acceleration of Renewable Energy Development for Electricity Supply is a critical policy instrument governing the early retirement of coal-fired power plants. As part of the electricity sector’s energy transition, the Minister of Energy and Mineral Resources (ESDM) is developing a roadmap for accelerating CFPP decommissioning, which will be finalized by September 2024 (Antara News, 2024). This roadmap will address: (i) Reduction of greenhouse gas (GHG) emissions from CFPPs; (ii) Strategies for accelerating CFPP retirement; and (iii) Alignment with other relevant policies. However, as of now, this regulation has yet to be issued. Additionally, the government has not yet implemented a carbon tax, while fossil fuel subsidies and incentives remain substantial (Tempo, 2025).

Table 1: Indonesia Government Policy Summary for Coal Early Retirement

No	Policy / Regulation Name	Issuing Institution	Main Content	Relevance to Coal Early Retirement
1	Presidential Regulation (PR) No. 112/2022	President of Indonesia	Acceleration of renewable energy development and coal power moratorium	Provides legal basis for developing coal retirement roadmap and policy support for transition.
2	Minister of SOEs Regulation No. 2/2023	Ministry of State-	Regulation on SOEs asset	Enables spin-off or divestment of coal

		Owned Enterprises	divestment for public interest	assets without being considered state loss.
4.	Minister of Energy and Mineral Resources Regulation No. 10 of 2025 concerning the <i>Roadmap for Energy Transition in the Power Sector</i>	Minister of Energy and Mineral Resources	A stringent and multi-stakeholder governance framework for the accelerated retirement of coal-fired power plants (CFPPs) in Indonesia	Provide guidelines in the implementation of the energy transition in the electricity sector, it is necessary to establish a road map for the energy transition in the electricity sector that supports the achievement of the net zero emission target of greenhouse gases
3	Minister of Finance Regulation No. 159/PMK.02/2022	Ministry of Finance	Compensation mechanism for PLN electricity tariff subsidies	Can be developed to include compensation for early coal retirement to ease PLN's financial burden.
4	JETP CIPP 2023 Document	JETP Secretariat /	Strategy, scenarios, and roadmap for early	Not a regulation, but serves as a strategic reference for coal

		Government of Indonesia	coal retirement and energy transition	retirement policy and financing decisions.
5	Energy Transition Mechanism (ETM)	ADB + CIF-ACT	Blended finance scheme for early retirement projects such as Cirebon-1	Serves as a model for incentives and financing through multilateral collaboration.
6	Proposed Technical Implementation Regulations	Government of Indonesia (proposed)	Technical regulation for early retirement implementation (asset valuation, compensation, legal status, etc.)	Needed to clarify technical mechanisms for implementing early retirement, especially for IPPs & PLN.

Source: Author's review of the Just Energy Transition Partnership Document in Indonesia

Key Provisions of PR 112/2022 on Coal Plant Restrictions PR 112/2022 prohibits the development of new CFPPs, except for: (i) CFPPs already stipulated in the Electricity Supply Business Plan (Rencana Usaha Penyediaan Tenaga Listrik, RUPTL) prior to PR 112/2022's enactment; or (ii) CFPPs meeting the following criteria:

1. Integrated with industries focused on natural resource value-added processing or designated as National Strategic Projects (Proyek Strategis Nasional) that significantly contribute to job creation and/or national economic growth.

2. Commitment to reducing GHG emissions by at least 35% within 10 years of operation (compared to Indonesia's 2021 CFPP emission average) through technological advancements, carbon offset mechanisms, and/or renewable energy integration.
3. Operational lifespan limited to no later than 2050.

Further, according to PR 112/2022 also outlines criteria for accelerating the retirement of state-owned CFPPs and those under PPAs developed by PT PLN (Persero), including: Capacity; Plant age; Utilization rate; GHG emissions; Economic value-added; Availability of domestic and international funding; and Access to domestic and international technology. However, the seven criteria appear insufficient to comprehensively capture key realities that warrant greater attention, a public discussion suggested three additional criteria—namely: the context of a just energy transition, power system reliability (reliability-neutral), and impacts on electricity tariffs and subsidies (cost-neutral).

The 'Just Energy Transition Partnership Indonesia - Comprehensive Investment and Policy Plan 2023' (JETP Document) references 'Indonesia Emas 2045' (Golden Indonesia 2045 Vision), which outlines five key targets: (i) Achieving per capita income parity with developed nations; (ii) Reducing poverty to near-zero percent while decreasing inequality; (iii) Strengthening global leadership and influence; (iv) Enhancing human resource competitiveness; and (v) Lowering greenhouse gas (GHG) emission intensity toward net-zero. The JETP document elaborates on a strategic roadmap for Indonesia's ambitious energy transition, highlighting substantial investment opportunities in clean energy; Critical challenges and barriers to be addressed, such Table 2): financial, regulatory, legal, governance, operational system, and social issues.

Table 2: Barriers for Coal Early Retirement

Barrier Category	Barrier Description
Financial and Investment Barriers	High early retirement costs; PLN's coal plant book value was estimated at US\$4.7 billion in 2022.
	Limited financing capacity of PLN due to high leverage and low profitability.
	Risk of breaching loan or bond agreements if plants are retired early.
Contractual and Regulatory Constraints	Rigid long-term PPAs with take-or-pay clauses limit early retirement flexibility.
	Lack of detailed technical regulations for early retirement implementation.
Legal and Governance Risks	Government officials fear legal accusations of causing state financial losses.
	Exposure to personal risk for officials; requires BPK and auditor support.
Operational and Systemic Barriers	System overcapacity and PPA terms hinder integration of renewables.
	Young coal plants have high book values, making compensation costs expensive.

Social and Local Economic Risks	Lack of transition planning that addresses local socioeconomic impacts.
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Source: Author's review of the Just Energy Transition Partnership Document in Indonesia

The government's plan to early retire the 660-megawatt (MW) Cirebon-1 CFPP in West Java was officially announced by the Minister of Energy and Mineral Resources, Bahlil Lahadalia, on February 3, 2025. The plant is scheduled to be decommissioned in 2035, seven years ahead of its original retirement date in 2042, and will be fully replaced by a renewable energy system—comprising a combination of solar power (700 MW and 346 MW of low-voltage systems), wind power (1,000 MW), and waste-to-energy technology (12 MW).

In parallel, the Pelabuhan Ratu CFPP has been designated as the second pilot project under the Just Energy Transition Partnership (JETP) and is planned for early retirement in 2037. However, the implementation of these initiatives faces significant challenges, particularly in relation to economic and financial viability, legal frameworks, and social implications.

However, the challenges faced are not easy, especially related to economic and financial, legal, and social aspects. To achieve a just transition, it is essential to examine not only the energy transition itself but also its social and economic impacts. At a minimum, four key challenges must be addressed, as identified by Landscape Indonesia (2025): job displacement, uneven impacts, financing, and the need for social dialogue.

The complexity of this process makes decision-making need to be done carefully. This is because if there is an impact on state losses, it will have legal consequences. This condition makes many policy makers unwilling to take the risk if they will later become prisoners of the Corruption Eradication Commission if the policies taken actually harm the country. Therefore,

guarantees or protection from the state are needed to make this difficult decision.

Based on the criteria of PR 112 of 2022 concerning the Acceleration of Renewable Energy Development for Electricity Supply, the government assesses that there are 13 CFPPs (total capacity of 4.8 GW) planned to be retired early, however, how can this not cause turmoil such as an increase in the basic cost of electricity supply (BPP), a shortage of electricity supply, and a burden on state finances. The government hopes that early retirement will not have an impact on these three things.

4. Data Collection Summary

Table 3 contains brief information related to the efforts that have been and will be made by the two companies to carry out the energy transition and reduce carbon emissions. Next, the information was deepened by referring to various news reports from trusted sources. The company's annual report was also used to complete the information. Various regulatory documents related to early retirement of CFPPs were also collected and analyzed to enrich the policy analysis.

Table 3: Energy Transition Strategy and Carbon Emission Reduction Targets at Firm Level

PLN Indonesia Power	Alamtri Power Indonesia
<i>Plant Owner's transition strategy</i> Throughout 2021, the Company has realized the energy transition through the development of renewable energy power plants by completing the	<i>Plant Owner's transition strategy</i> In 2023, we will further strengthen our commitment to environmental social governance (ESG) by issuing a Net-Zero Emissions (NZE) statement

construction of the Gunung Wugul PLTM / Microhydro (3 MW), Grati Landbase PLTS / Solar power plant (1.5 MWp), and Nusa Penida Hybrid PLTS (3.5 MWp). In addition, in achieving the renewable energy mix, in 2022 PLN Indonesia Power has commercialized cofiring at 11 CFPPs / Coal Fire Power Plant, namely Suralaya 1-4 CFPPs, Suralaya 5-7 CFPPs, Suralaya 8 CFPP, Labuan CFPP, Lontar CFPP, Pelabuhan Ratu CFPPs, Adipala CFPP, Sanggau CFPP, Sintang CFPP, Jeranjang CFPP and Barru CFPP which have an impact on increasing renewable energy production in the energy mix.	and formulating an internal transition target so that around 50% of total revenue is generated from non-thermal coal businesses by 2030 at the latest. This target will be achieved by increasing business in areas that support Indonesia's green economy ecosystem, for example by building an aluminum smelter, exploring opportunities in various environmentally friendly mineral products, developing a renewable energy business, and expanding the metallurgical coal market.
<i>Plant Owner's emission reduction target</i> "PLN Indonesia Power owns and manages power plants with green and clean energy, including geothermal, hydro power plant, microhydro and solar PV, amounting to 1,510 MW + 5 MWp. Furthermore, PLN Indonesia Power contributes to the acceleration of the new and renewable (EBT) mixed in Indonesia through the development of EBT power plants and Co-firing CFPP, so that it is expected that the new and	<i>Plant Owner's emission reduction target</i> In its 2024 Annual Report, Alamtri Resources Indonesia outlined several strategic steps and targets related to carbon emission reduction. The company has committed to achieving Net Zero Emissions (NZE) by 2060 or earlier, aligning with the Indonesian government's national climate goals. Additionally, Alamtri aims for 50% of its total revenue to

renewable energy mix in PLN Indonesia Power will reach 30% of the total installed capacity of the power plants managed in 2028” (PLN, 2023).	be derived from non-thermal coal businesses. As part of its decarbonization timeline, the company also announced plans to divest from thermal coal operations, explore low-carbon technologies, and participate in carbon markets. Furthermore, the company is actively developing several RE projects, including solar power plants, battery energy storage systems (BESS), wind power, micro-hydro plants, and large-scale hydropower—most notably the Mentarang Hydropower Plant in North Kalimantan, which will have a capacity of 1,375 MW.
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Source: PT PLN (Persero) (2024) ; PT Alamtri Resources Indonesia Tbk. (2024).

4.1 Narrative from PT. PLN Indonesia Power

The early retirement of CFPPs in Indonesia, particularly units I to IV of the Suralaya plant, has become a matter of serious consideration due to the aging infrastructure and growing environmental concerns. These units, constructed between 1984 and 1989, have a combined capacity of 1,600 MW. Although technically feasible to decommission, their early retirement poses significant challenges due to their role in providing base load power and their relatively low production costs, which fall below the national electricity tariff, thereby reducing the government's electricity subsidy burden.

The transition away from coal faces multiple obstacles. Three primary challenges include limited internal investment incentives, regulatory and contractual obligations, and policy-driven pricing structures. One notable example is the DMO, which mandates that 25% of coal production be allocated for domestic consumption at a fixed price of USD 70 per ton. This policy, which has remained unchanged since 2018, functions as an indirect subsidy that burdens mining companies—particularly when international coal prices exceed the regulated price. As a result, coal remains artificially cheap and more attractive than renewable energy (RE), which lacks comparable support mechanisms.

Indonesia's energy transition is further hindered by the absence of a carbon tax, a lack of incentives for companies to retire CFPPs early, and a rigid planning process embedded in the Electricity Supply Business Plan (RUPTL). Amending the RUPTL is complex due to the involvement of multiple stakeholders, making it difficult to respond quickly to shifts in electricity demand. Consequently, replacing CFPPs capacity in a timely manner becomes highly complicated. Thus, any replacement strategy requires sufficient renewable energy reserve capacity to maintain system reliability.

Nonetheless, investment trends are gradually shifting. Technologies such as biomass with carbon capture and storage (CCS), and solar power plants (PLTS) integrated with battery systems, are becoming increasingly attractive. For instance, Indonesia Power (IP) has finalized a contract for the development of a 110 MW floating solar PV plant in Saguling and is currently exploring similar projects across five other locations, with a combined capacity of 500 MW.

Ideally, renewable energy projects intended to replace coal plants should be treated as integral components of early retirement efforts. Treating them as entirely new and separate projects necessitates competitive bidding processes, which may discourage investors from voluntarily retiring their coal assets.

The economic feasibility of early retirement is largely influenced by the loss of operational revenue and unresolved book value associated with ongoing maintenance and operational costs. The DMO scheme enables coal to be procured at a lower cost, thus maintaining economic viability. However, this situation distorts the market and disadvantages RE, particularly since the government limits RE purchase prices to a maximum of 85% of the regional electricity generation cost (BPP).

To address these financial challenges, coal plant owners require government guarantees and risk-sharing mechanisms to ensure a level playing field. This includes aligning early retirement strategies with RE development policies underpinned by state support. Tax credits and guaranteed returns on investment may further enhance investor appeal. Although the carbon market presents potential opportunities, it has not demonstrated significant progress since its launch in 2023.

International partnerships play a crucial role in the energy transition. For example, IP's collaboration with Saudi Arabia's ACWA Power led to the construction of the Saguling floating solar plant, largely funded through international loans. A similar project is being pursued in Lake Singkarak. Nonetheless, regulatory uncertainty and concerns over investment returns remain significant barriers to attracting broader foreign investment.

Energy security continues to be a major concern. Early retirement of coal plants could impact grid stability, supply reliability, and subsidy structures. As such, Indonesia must invest in infrastructure upgrades—particularly transmission lines and storage facilities—to accommodate the intermittency of RE sources. This approach may lead to temporary oversupply, but it is essential for a smooth and gradual coal phase-down, which may be a more appropriate term than “early retirement” in the Indonesian context.

From a social perspective, the impact of early retirement is expected to be minimal and manageable, especially if new RE capacity can absorb the affected workforce. However, successful transition requires regulatory clarity granting companies the right to develop replacement RE projects, along with government support in land acquisition for large-scale solar developments.

Globally, international climate policies and the rising demand for green electricity are exerting additional pressure. Initiatives such as the Carbon Border Adjustment Mechanism (CBAM) and the growing use of Renewable Energy Certificates (RECs) by foreign companies are stimulating demand for clean energy. While Indonesia has yet to access international climate financing mechanisms such as the Green Climate Fund, partnerships between domestic private entities and foreign counterparts remain the principal source of transition funding.

4.2 Narrative from PT. Alamtri Power Indonesia

The early retirement of newly established CFPPs in Indonesia, such as those operated by PT Alamtri, faces significant challenges. Although there have been initiatives by institutions such as the Indonesia Investment Authority (INA), early retirement is currently considered unfeasible because these plants have only recently commenced operations, employ the latest technologies, and still carry substantial debt burdens. While the companies do not entirely reject the idea, they emphasize that early retirement is more appropriate for older CFPPs that have nearly completed their debt repayment. Specifically, the Batang CFPPs, which employs ultra-supercritical technology, is deemed sufficiently efficient in terms of emissions, making it a less appropriate target for emission reduction through early retirement.

Three key challenges in the coal-to-renewable transition include limited internal investment incentives, concerns over IRR, and the social impacts on workers and local communities. In prioritizing early retirement, the remaining

operational lifespan of a plant is a critical factor. Since these CFPPs are relatively new, the economic rationale for early retirement remains weak. The financial risks include potential loss of investment returns and disruptions to financial agreements or PPAs.

A major obstacle in financing the transition to renewable energy is the lack of access to low-interest or green financing, compounded by the relatively low profitability of renewable energy projects. Currently, financial instruments such as green bonds or climate financing mechanisms are not available to support early retirement of these plants. Furthermore, the lack of strong commitment to transition limits access to international climate finance.

To mitigate the financial risks associated with the transition, CFPPs owners require government-backed guarantees and effective risk-sharing mechanisms. Incentives such as tax credits, feed-in tariffs (FiT), and low-interest loans or grants can help promote interest in renewable energy development. However, these incentives must be competitive, considering that CFPPs currently benefit from the Domestic Market Obligation (DMO) mechanism, which is indirectly subsidized by the coal mining industry.

Stakeholders acknowledge the importance of carbon markets and carbon pricing, though implementation in Indonesia remains limited. The effectiveness of such policies will depend heavily on clear role definitions, equitable cost-sharing, and stronger supporting regulations. While carbon pricing is promising, questions persist about who will bear the associated costs.

From an energy security perspective, abrupt shutdowns of CFPPs may compromise grid stability and reliability. Therefore, a more realistic approach would be to modernize existing CFPPs while simultaneously expanding renewable energy capacity. Infrastructure improvements, particularly in transmission networks and energy storage facilities, are critical to supporting renewable energy's intermittent nature.

Socially, CFPPs contribute significantly to local economies due to their relatively high labor absorption. Replacing CFPPs entirely with solar power (PLTS) would result in much lower employment levels, and implementing a “just transition” strategy is essential. Measures must be taken to mitigate economic and social impacts, especially in regions heavily dependent on the coal industry.

From a policy standpoint, the focus should shift away from enforcing early retirement of CFPPs and toward accelerating renewable energy development. This includes implementing feed-in tariffs by PLN, offering fiscal incentives such as tax exemptions for renewable energy projects, and establishing transparent mass tender systems. Additionally, PLN could manage climate-related loan schemes and channel them to renewable energy developers.

Although the government has introduced initiatives such as the Just Energy Transition Initiative (JETI), the role of the private sector needs to be strengthened, rather than relying solely on government-led programs. A bottom-up approach initiated by the private sector may expedite the development of renewable projects, with the government providing subsequent support.

In international cooperation, foreign investment can play a pivotal role in renewable energy development, despite existing challenges. Renewable projects' high costs and low return expectations deter many foreign investors. Therefore, fiscal policy must be directed toward creating a more balanced incentive structure between fossil fuel and renewable energy investments.

While international climate financing mechanisms such as the Green Climate Fund and the World Bank appear promising, their technical implementation still faces significant hurdles. Debt restructuring and aligning domestic CFPPs retirement plans with global business objectives present notable barriers. Consequently, many stakeholders suggest that foreign investors should focus

on supporting new renewable energy projects, particularly those replacing aging coal plants.

4.3 Generalisation of Findings

Issues and Concerns with the Early Retirement of Coal Power Plants

The ambition to retire CFPPs may not be straightforward, particularly in the case of older plants. This is due to the potential risks posed to system reliability and an increase in electricity tariff or subsidy. In contrast, for newer plants—given the adoption of advanced technologies and the stability of investment financing—discussions around early coal retirement become less relevant or significant.

Economic and Financial Barriers

The Domestic Market Obligation (DMO) scheme keeps coal prices artificially low, making coal more competitive than renewable energy and thereby distorting the market. Access to green financing and fiscal incentives remains highly limited. Currently, there are no available green bonds or international climate finance instruments to support early retirement, particularly for recently commissioned coal-fired power plants.

Incentives for Coal Plant Owners

Government-backed guarantees and risk-sharing mechanisms are essential to enable a just and equitable transition. Incentives such as tax credits, feed-in tariffs (FiT), low-interest loans, or grants are critical to promoting investment in renewable energy development. Granting “first-mover” advantages to companies willing to retire their coal assets early—such as priority access to renewable energy project development—should be supported through enabling regulations, including price mechanisms, land access, PPAs, and streamlined permitting processes.

Policy and Regulatory Barriers

The DMO and electricity subsidy policies result in artificially low prices for coal-based electricity, undermining the competitiveness of renewable energy. The absence of a carbon tax, rigid electricity planning frameworks (e.g., the Electricity Supply Business Plan/RUPTL), and complex planning processes further hinder the energy transition. Policy focus should shift away from enforcing early retirement toward accelerating renewable energy deployment, including through reforming procurement mechanisms and enabling PLN to manage climate finance effectively.

Role of Foreign Investment and International Support

The government has established the Energy Transition and Green Economy Task Force through Coordinating Minister for Economic Affairs Decree No. 141 of 2025. This task force comprises four working groups: green energy, green industry, green partnerships and investment, and social, economic, and human resource development. The task force is mandated to ensure that projects under the Just Energy Transition Partnership (JETP) framework are effectively implemented.

Table 4 illustrates that the availability of funding sources receives the highest weight in the effort to accelerate the early retirement of coal-fired power plants. This indicates that the availability of financing is central to the implementation of this process. Notably, new variables—previously unregulated under Presidential Regulation No. 112 of 2022—have emerged with substantial weights following funding availability. These include system reliability, cost neutrality, and inclusiveness. As discussed in the previous section, achieving both system reliability and cost neutrality poses significant challenges. When combined, the weights of these four criteria account for 60.5%, suggesting that pursuing early retirement of coal plants—particularly large-scale units with low basic electricity supply costs—can resemble a "mission impossible." In contrast, the

environmental aspect, which constitutes the core rationale for coal retirement, receives a relatively low weight of only 9.3%.

Table 4: Weighting of Analytical Hierarchy Process Result Criteria for CFPP Early Retirement

No	Criteria	Weight (%)
A. In Accordance with Presidential Regulation No. 112 of 2022		
1	Capacity of coal-fired power plant (CFPP)	4.4%
2	Age of the power plant	4.4%
3	Utilization (capacity factor of CFPP)	5.2%
4	Availability of technological support	6.4%
5	Greenhouse gas emissions from CFPP	9.3%
6	Economic added value	9.8%
7	Availability of funding support	27.1%
B. Additional Criteria in the Roadmap		
8	Reliability of the electricity system	13.0%

9	Impact of increased basic electricity supply cost on electricity tariffs	10.3%
10	Implementation of just energy transition principles	10.1%

Source: Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 10 Year 2025 Concerning Road Map Energy transition in the Electricity Sector – Table

However, international partnerships, such as the floating solar power project between Indonesia Power and ACWA Power, illustrate the potential of foreign investment in supporting energy transition efforts. Key obstacles include regulatory uncertainty and concerns over return on investment. While mechanisms such as the Green Climate Fund and World Bank financing appear promising, their implementation faces technical and structural challenges, including debt restructuring and alignment with global business objectives. Stakeholders suggest that foreign investors should prioritize supporting new renewable energy projects over financing the early retirement of currently operating coal-fired plants.

By considering the generalization of the findings, various challenges can be summarized in the Table 5, as well as potential solutions that can be implemented based on the views of the informants and considering the perspective of the experiences of several countries that have also implemented this policy, such as Chile, South Africa, the United States and Germany.

Table 5: Summary of Challenges and Solutions towards Optimal Early Coal Retirement

Major Challenges	Solutions
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Disruption of the reliability of the electrical system	To ensure that supply reliability is not compromised by early retirement plans, the process should begin with older coal-fired power plants that have relatively small capacities and low utilization rates. Simultaneously, efforts to scale up renewable energy capacity must be further promoted and supported through the modernization and integration of the national electricity grid. This includes the addition of variable renewable energy (VRE) sources, such as solar and wind, complemented by energy storage systems (e.g., battery storage), thereby establishing a substantial reserve margin is necessary. Additionally, it is feasible to repurpose several existing coal power plants into hybrid projects by integrating solar, wind, hydro, biomass, and battery technologies.
Economic feasibility: tariff, subsidy, financing model; incentives	Concerns regarding potential increases in electricity tariffs or the fiscal burden of subsidies can be addressed by enhancing financing mechanisms, such as implementing blended finance schemes—including grants, concessional loans, and green bonds—or by establishing dedicated transition bonds with low interest rates to support the early retirement of coal-fired power plants. The government should undertake reforms of household-targeted electricity subsidies to ensure efficiency and equity, while also instituting transparent and consistent long-term tariff adjustments based on the cost-of-service principle. Additionally, offering contract restructuring facilities for independent power producers (IPPs) willing to accelerate CFPPs retirement—with appropriate fiscal or tariff-based incentives—could facilitate the transition. Setting a carbon pricing floor would further contribute by generating a credible long-term price signal. Finally, strengthening Integrated Resource Planning (IRP) is essential to guarantee the timely and cost-effective deployment of competitive replacement generation capacity.

Lack in consistent policy direction and high political risks	It is essential to develop a comprehensive national roadmap that addresses both upstream and downstream aspects of the energy transition. This should be undertaken through the promotion of multi-stakeholder dialogue, with greater inclusion of the private sector, as transition policies grounded in consensus-driven governance are generally more resilient to political shifts. Moreover, robust support should be extended to companies entering into voluntary early retirement agreements. A bottom-up approach—when reinforced by strong regulatory frameworks and adequate national-level funding—significantly enhances the likelihood of successful implementation.
Undergoing a just energy transition process	Promoting local economic development post-closure and providing reskilling and upskilling for affected workers

Source: The author's synthesis of interviews with Indonesia Power, Alamtri, and enriched with literature studies from NewClimate Institute (2025); GIZ & Powering Past Coal Alliance. (2022).; Financial Times. (2024, July 28).

5. Policy Evaluation

Referring to existing policies and generalization of findings, we identify two interconnected directions that require a strengthening strategy, by placing the economic and financial side as a pivotal factor, namely: economic and financial with operational challenges; then economic and financial with policy and regulatory challenges.

Economic- financial supports with operational challenges

With regard to economic and financial aspects, it is crucial to engage in dialogue with business actors to clarify mechanisms and implementation strategies. In this context, the value positions of PLN-owned and Independent

Power Producer (IPP)-owned CFPPs will differ significantly in their responses to such policies. Furthermore, it is necessary to assess whether the current policy instruments are sufficient to effectively incentivize early retirement of CFPPs.

The JETP document outlines three measures that have been or will be undertaken: (i) the implementation of Energy Transition Mechanism (ETM) projects, such as the early retirement of Cirebon-1, supported by concessional loans from CIF-ACT and commercial financing from the ADB; (ii) the provision of compensation for unrecovered book value, outstanding debt, and equity, with potential renegotiation of take-or-pay clauses; and (iii) for PLN-owned power plants, asset divestment may be facilitated through a spin-off strategy and accelerated depreciation.

Insights from the case of the Suralaya Units 1–4 suggest that, despite operating for over 30 years and having fully recovered capital costs, the plant continues to operate and plays a role in stabilizing the base electricity supply price. This demonstrates that existing mechanisms are not yet adequate to address both the intended and unintended consequences of early retirement.

Thus, while the ETM mechanism can effectively structure financing arrangements and determine compensation values, its implementation faces challenges related to the *unreplaced influence* of early-retired plants, particularly regarding their operational role in ensuring system stability. Consequently, the application of ETM to large, aging power plants may be viable only in limited contexts. If implemented, it must be accompanied by safeguards to prevent adverse impacts on overall system reliability.

Economic- financial supports with policy and regulatory challenges

Despite criticism of the weak public participation in the drafting of these regulations, the Regulation of the Minister of Energy and Mineral Resources of the Republic of Indonesia No. 10 of 2025 stipulates that the acceleration of the termination of the operational period of coal-fired power plants (PLTU) can only

be undertaken if funding support is available and has been preceded by a comprehensive technical study. This study is to be conducted by PT PLN (Persero) under the assignment of the Minister of Energy and Mineral Resources. The study must: (i) be completed within a maximum of six months; (ii) address technical, legal, commercial, and financial aspects, including governance and adherence to the principles of business judgment rules; and (iii) may incorporate references from independent institutions.

Thus, it appears that this regulation wants to ensure that early retirement has a neutral effect on PLN's finances. From a cooperation standpoint, the regulation requires PLN to enter into a formal cooperation agreement with the funding entity. Furthermore, if the CFPP designated for early retirement is developed by an IPP, then amendments to the Power Purchase Agreement (PPA) must be made. This clearly shows that early coal retirement must be cost neutral for both PLN's finances and electricity subsidies.

The requirement for the availability of domestic and foreign funding support also makes financing the retirement of coal-fired power plants difficult because there is no budget item in state spending designated for this purpose. Meanwhile, the requirement for 'cost neutrality' in the conditions of state-regulated coal pricing policies makes it difficult for renewable energy to replace coal, unless there is an affirmative source of funding to make it competitive with coal.

5. Conclusion and Policy Recommendations

Indonesia has demonstrated its commitment to reducing carbon emissions in the power generation sector, as evidenced by the launch of the Just Energy Transition Partnership (JETP). However, it remains difficult to envision how the early retirement of CFPPs will be implemented in practice, as the process has yet to be formally undertaken. While the government has established various regulatory frameworks to support this transition, the associated risks appear to

be insufficiently addressed, thereby limiting the confidence of key stakeholders—including the government itself, PLN, and the private sector—to proceed with such measures.

The politics of coal-fired power plant (CFPP) early retirement can be observed through the significant weight assigned to funding considerations. This reflects an acknowledgment of the fiscal and systemic risks inherent in the policy. This study shows that, in the absence of adequate financial support, early retirement efforts may instead lead to increased electricity subsidies, higher electricity tariffs for consumers, and disruptions to national power system reliability.

Meanwhile, the environmental dimension—which constitutes the moral and normative basis for CFPP retirement—is assigned a relatively low weight. This suggests a tendency toward the technocratization of policy, whereby environmental considerations are subordinated to operational and economic factors. This situation also illustrates the government's pragmatic approach to managing the risks and complexities of energy transition policy.

We argue that natural retirement—allowing CFPPs to operate until the end of their economic life without extension or renewal—is more practical, particularly for large-scale coal-fired power plants.

Early closure of such plants could lead to rising electricity prices, supply instability, and increased fiscal burdens, all of which are major obstacles to implementation. The situation becomes increasingly difficult to change due to policies related to the Domestic Market Obligation (DMO). Therefore, without reforming the DMO policy, efforts to accelerate the early retirement of coal-fired power plants will not only be hindered but will also constrain the acceleration of investment in renewable energy.

A supportive policy ecosystem is therefore essential and need to include: the introduction of carbon pricing and market mechanisms, improved access to

green financing, and the gradual reduction of fossil fuel subsidies and the Domestic Market Obligation (DMO). Furthermore, findings from two case studies suggest that early retirement and the promotion of renewable energy are more feasible under specific conditions:

- retirement of CFPPs with zero book value,
- phasing out small-scale coal plants, and
- replacing diesel rental plants with renewable energy sources.

These observations are consistent with the study by Do and Burke (2024), which contends that policy efforts should prioritize the development of renewable energy and the cessation of new CFPPs construction, rather than attempting the premature closure of existing plants. This perspective is also echoed by representatives from Indonesia Power (IP) and Alamtri.

The Indonesian government has long provided substantial support for coal utilization, primarily through electricity subsidies and the DMO policy. To establish a more conducive environment for renewable energy development, the government need to consider:

- phasing out electricity subsidies,
- ensuring equitable access to green financing,
- limiting the economic advantages of coal to a managed transition period, and
- implementing robust carbon pricing mechanisms, including carbon taxes.

Ultimately, the government must begin to shift its institutional and financial support away from coal and toward renewable energy, enabling fair market competition and environmental accountability. Prioritizing the cessation of new coal plant development and accelerating renewable energy infrastructure deployment appears to be a more realistic and effective strategy than enforcing early coal retirements.

Policy Recommendations

1. Economic and Financial Barriers

Given the continued substantial support for fossil energy sources, a market-based green transition financing model alone is insufficient to drive systemic change. In this context, the blended finance approach presents strong prospects for development. This model integrates public, philanthropic, and private capital, thereby generating a high leverage effect to mobilize large-scale investment.

Currently, PT Sarana Multi Infrastruktur (SMI) plays a key role in mobilizing resources from commercial lenders, capital markets, Multilateral Development Banks (MDBs), and the state budget—channeled through the Government Investment Fund (Pusat Investasi Pemerintah)—to be consolidated into a blended loan facility for PLN (the state-owned electricity company). The disbursement of this blended finance is governed by a set of Disbursement Linked Indicators (DLIs). SMI is responsible for formulating these DLIs in consultation with the Government and international partners. A list of exclusions on the use of loan proceeds will also be specified in the loan agreement with PLN. Throughout the loan implementation period, SMI will conduct monitoring to ensure compliance with the agreed-upon DLIs.

The ESG Leaders Index in the Indonesian capital market holds the potential to contribute directly to financing the green energy transition and the early retirement of coal-fired power plants (CFPPs). However, a series of policy strategies and incentive mechanisms are still required to realize this potential. The criteria embedded within ESG assessments need to be made more specific in order to capture the extent to which companies contribute to energy transition and the decarbonization of the power sector. This could be operationalized by placing greater emphasis on indicators such as: direct investment in renewable energy; reduction of exposure to coal-based assets; and concrete commitments to coal phase-out roadmaps.

Furthermore, to encourage listed companies included in the ESG Leaders Index to allocate capital toward energy transition projects, the government may offer fiscal incentives or preferential financing schemes to those ESG Leaders that invest in blended finance instruments for CFPP retirement or green bonds for the development of clean energy infrastructure.

2. Incentives for Coal Plant Owners

- a. Immediately close small scale steam coal power plants whose book value is zero, while still considering their impacts; it can be considered to provide an opportunity for owners to build renewable energy with an attractive scheme
- b. Encourage acceleration of renewable energy investment, especially to replace coal base load, for example with the FiT (feed-in tariff) policy

3. Social and Workforce

Workers should be given help to find new jobs in green industries. Open green energy-based training at job training centers for both up-skilling and re-skilling purposes. The government can play a facilitative role in supporting workers who seek employment in green industries. For instance, it may open green energy-based training programs at vocational training centers, aimed at both up-skilling and re-skilling the workforce. Furthermore, the government could collaborate with the Professional Certification Institute (LSP) Green Jobs Indonesia to provide scholarships for individuals pursuing competency certifications in the sustainability sector. In addition, the Human Resources Development Agency for Energy and Mineral Resources (BPSDM ESDM) already provides training and certification in the fields of renewable energy and energy conservation. The scope and reach of these programs should be expanded, as they are crucial in preparing a competent labor force capable of supporting the transformation toward a green industrial sector in the energy domain.



Economic and Financial Pathways for Accelerating Coal Power Plant Transition: Evidence from Malaysia

Executive Summary (Malaysia)

Malaysia is advancing its energy transition with a strong commitment to phase out coal and reach net-zero emissions by 2050. Guided by the National Energy Transition Roadmap (NETR) and the National Energy Policy (2022–2040), the country is shifting towards cleaner energy sources. A key milestone in this journey is the early retirement of coal plants, including major facilities such as Jimah East and Manjung, operated by TNB Power Generation Sdn. Bhd. (TNB Genco). This report explores how Malaysia can accelerate this transition while safeguarding energy reliability, maintaining financial stability, and protecting the well-being of affected communities. The study identifies several core barriers to early coal plant closure based on insights from the targeted survey

with TNB Genco and energy experts. These include high decommissioning costs, unrecovered capital investments, and rigid PPAs that impose financial penalties for early exit. Plant owners also face difficulty accessing affordable financing for renewable energy projects due to policy uncertainty and investor risk perceptions. Although Malaysia has taken bold steps, such as banning new coal plant developments and targeting 70 percent renewable energy capacity by 2050, existing frameworks still fall short of enabling timely and cost-effective coal retirement. Supportive instruments such as the Green Investment Tax Allowance and the Green Technology Financing Scheme have spurred some growth in renewables. However, they do not directly address the structural challenges facing coal-dependent operators. Moreover, promising international financing channels, including the Green Climate Fund, Energy Transition Mechanism (ETM), and Malaysia's SRI Green Sukuk, remain underutilized due to complex eligibility requirements and the lack of bankable transition plans. To close these gaps, the report recommends a series of practical and inclusive interventions. These include developing structured compensation frameworks for early coal phase-out, reforming PPAs to enable more flexible termination, and expanding access to concessional financing and government-backed guarantees. Strengthening carbon pricing, streamlining approval processes for renewable energy projects, and modernizing grid infrastructure is also key. Equally important are workforce reskilling initiatives and local economic diversification programs that ensure a fair and equitable transition. With bold leadership and coordinated efforts, Malaysia can turn its coal phase-out strategy into a catalyst for green investment, job creation, and long-term energy resilience, positioning itself as a model for clean energy transition in the region.

1. Introduction

1.1. Project Overview

Malaysia is entering a decisive stage in its energy transition, aiming to phase out coal and achieve net-zero greenhouse gas (GHG) emissions by 2050, as outlined in the Twelfth Malaysia Plan (2021–2025) and supported by the National Energy Policy 2022–2040. This vision is further reinforced by the National Energy Transition Roadmap (NETR) introduced in 2023, which sets out the country's Responsible Transition (RT) Pathway 2050. The RT Pathway aims to shift Malaysia's energy generation away from fossil fuels, currently making up 96% of the energy mix, towards more sustainable alternatives, reducing this dependency to 77% by 2050. Renewable energy sources such as solar, hydropower, and bioenergy are expected to rise from 4% to 23% of the national energy mix, with natural gas playing a transitional role in this process. However, despite the clear ambition, coal has experienced the fastest growth among fuels in recent years due to its affordability and reliability, particularly in Peninsular Malaysia. This growth poses a significant challenge as the nation seeks to reduce emissions while maintaining energy security and economic competitiveness.

This study investigates the feasibility and policy requirements for the early retirement of two major coal-fired plants operated by TNB Power Generation Sdn. Bhd. (TNB Genco) – Jimah East and Manjung. As the primary power generation subsidiary of Tenaga Nasional Berhad (TNB), TNB Genco plays a central role in powering Malaysia's grid while aligning with national climate goals. TNB has pledged to halve coal generation by 2035 and completely phase it out by 2050, which aligns with NETR and its internal Energy Transition Plan (TNB Sustainability Report, 2023). However, realizing this ambition demands overcoming significant economic and structural barriers, including high decommissioning costs, rigid PPAs, and regulatory bottlenecks. Based on policy analysis and stakeholder interviews, this study aims to identify these barriers and explore viable solutions from financial mechanisms such as green sukuk and concessional loans to technical innovations such as co-firing and carbon capture. By doing so, it offers evidence-based recommendations to

policymakers, utility providers, and investors, ensuring that Malaysia's coal phase-out is not only environmentally necessary but also socially just and economically sound.

1.2. Study Objectives

Malaysia's commitment to a low-carbon future has placed the energy sector at a turning point, with the early retirement of CFPPs emerging as a key priority in achieving national climate goals. This study contributes to that effort by exploring practical and fairways to accelerate the transition from coal to cleaner energy sources. Focusing on the Tuanku Muhriz (Jimah East) and Sultan Azlan Shah (Manjung) power plants, both major contributors to the electricity grid and national emissions, the report aims to identify what it would take to phase out these plants earlier than planned. Operated by TNB Genco, these plants underscore the challenge of balancing energy security with environmental responsibility.

This study focuses on the real-world hurdles that plant owners face when considering early retirement. These include financial risks, regulatory uncertainty, and binding long-term contracts such as PPAs, which currently guarantee returns for continued coal use. Using a case-specific approach, this report examines the types of support such as compensation, financing options, and infrastructure reuse that could help make early closure feasible. This study lays out realistic solutions to support a transition pathway that aligns climate responsibility with energy and economic needs by providing a clear-eyed view of the economic realities and exploring practical climate finance tools.

2. Local Survey and Data Collection

2.1. Interview Setup

To support the development of a practical and inclusive Just Transition strategy in Malaysia, this study gathered qualitative insights through a

structured interview process. A pre-designed questionnaire, tailored to the national context, was used to identify key challenges faced by coal plant operators in retiring their assets early and transitioning to cleaner energy sources. The questions focused on economic, regulatory, and financial barriers and plant owners' views on viable financing models, compensation mechanisms, and the social and infrastructure-related impacts of such a shift. These grounded insights are essential to ensure that this report's policy recommendations and financial strategies are realistic and locally relevant.

To provide industry and system-level perspectives, structured interviews were conducted with Tenaga Nasional Berhad Power Generation Sdn Bhd (TNB Genco) and two experienced energy experts. TNB Genco was selected as the primary case study, given its role as one of Malaysia's largest coal power operators. The company owns and operates two major coal-fired power plants: the Tuanku Muhriz Power Station (Jimah East) and the Sultan Azlan Shah Power Station (Manjung). The organization's registered address is TNB Power Generation Sdn Bhd, Aras 2, Bangunan TNB Genco, No. 129, Jalan Bangsar, 59200 Kuala Lumpur.

To complement TNB Genco's insights, two energy experts were invited to contribute:

- Assoc. Prof. Dr. Norasikin Ahmad Ludin, Deputy Director at Solar Energy Research Institute, The National University of Malaysia.
- Mr. Dhana Raj Markandu, Senior Analyst at the Institute of Strategic & International Studies (ISIS) Malaysia.

Due to scheduling constraints, in-person and virtual interviews were not feasible. Instead, the structured questionnaire was distributed via email. All three respondents returned completed questionnaires, providing valuable inputs that reflect the operational realities, policy limitations, and financial considerations associated with coal phase-out in Malaysia. This report uses

these findings to ensure that recommendations are grounded, actionable, and reflect stakeholder realities.

2.2. Data Collection Summary

Tenaga Nasional Berhad (TNB), Malaysia's national utility company, has outlined a clear and strategic approach to support its long-term goal of achieving net zero carbon emissions by 2050. Central to this strategy is the transformation of TNB Power Generation Sdn Bhd (TNB Genco), the subsidiary responsible for electricity generation, towards cleaner and more sustainable energy sources. This transition involves a series of deliberate and phased measures, including the early retirement of selected coal-fired power plants ahead of their original schedule, the repowering of existing facilities using advanced green technologies, and the establishment of strategic collaborations with reputable technology partners to facilitate knowledge sharing and innovation. A gradual reduction in coal generation capacity is planned, reflecting a significant shift in the energy mix. In parallel, efforts are underway to explore and implement renewable solutions, such as the use of green hydrogen to repurpose retired coal and gas plants. As part of its firm stance on sustainability, TNB has confirmed that no new coal power plants will be developed. Existing coal-fired facilities will continue to operate solely to meet current energy demands in the short to medium term, ensuring system reliability while supporting the broader goal of decarbonising Malaysia's energy sector.

To support these principles, structured interviews were conducted with TNB Power Generation Sdn Bhd (TNB Genco) and two energy experts. TNB Genco was selected as the focal case study because it is one of Malaysia's largest coal power producers. As of 2023, TNB Genco contributed 51.11% of the national power market share, making it a major player in Malaysia's energy transition. The organization's 2023 fuel mix was 41.70% coal, 32.36% gas, 16.19% hydro, and 8.13% renewable energy (solar/biomass).

The TNB GENCO operates two key coal plants: Jimah East Power (JEP) [Tuanku Muhriz Power Station (Jimah East)] in Negeri Sembilan, commissioned in 2019 with an installed capacity of 2000 MW and an expected lifespan of 19 more years and TNB Janamanjung [Sultan Azlan Shah Power Station (Manjung)] in Perak, commissioned in phases (2005, 2015, 2017), with a total installed capacity of 4080 MW and remaining lifespan of 5 to 15 years. These plants are privately owned and operate based on dispatch or generation plans. Financially, JEP is operated by 3B Power Sdn Bhd, a joint venture where TNB Genco holds 70% ownership, while TNB Genco fully manages TNB Janamanjung. These details were critical in understanding the scale and complexity of early coal retirement and transition mechanisms in Malaysia.

2.2.1 Transition Strategy and Emission Reduction Targets

In August 2022, Tenaga Nasional announced plans to retire some of its CFPPs in Malaysia earlier than scheduled and repower them with green technology. As part of its National Energy Transition Roadmap (NETR) (2023), Malaysia is looking to reduce its installed capacity of coal power plants by half by 2030, with a complete phase-out by 2050. As noted by Assoc. Prof. Dr. Norasikin Ahmad Ludin, "Malaysia's coal transition strategy reflects a clear national goal: to reduce coal-fired power generation by 50% by 2035 and fully retire all coal plants by 2044." Plant owners, particularly Tenaga Nasional Berhad (TNB), have proactively supported this ambition through measures such as the early retirement of coal plants.

TNB Genco has articulated its commitment through the TNB Genco Energy Transition – Sustainability Pathway 2050. The strategy focuses on reducing greenhouse gas (GHG) emission intensity. It aligns with Malaysia's national climate goal to reduce carbon emission intensity by 45% against GDP by 2030 and to achieve net-zero emissions by 2050. TNB Genco explicitly supports these targets and has incorporated them into its transition roadmap. One of the levers for achieving these goals is the "No New Investment and Potential Phase-

Down of Coal Capacity," signalling the company's intent to avoid building new coal infrastructure and gradually decommission existing coal assets in alignment with national objectives.

The organization aims "to reduce emission intensity by 35% through the wide adoption of sustainable fuel and clean power plants and reduce coal capacity by -50% in 2035." Additionally, TNB Genco aims to be coal-free by 2045 and aspires to achieve net-zero GHG emissions by 2050, directly supporting Malaysia's broader emission reduction pathway.

These early retirements may involve renegotiating PPAs or decommissioning facilities ahead of schedule. At the same time, there is increasing investment in alternative energy sources, particularly natural gas and solar. "Existing coal plant infrastructure may be repurposed for renewable energy projects or energy storage," she added, reinforcing the potential for a more flexible and adaptive transition. By 2050, renewable sources such as solar, hydro, and biomass will contribute significantly to the national energy mix, while coal will be largely phased out. This transition is expected to help lower carbon emissions, reduce reliance on fossil fuels, and create new opportunities in the clean energy sector.

The transition also recognizes the need to carefully manage economic and social impacts to ensure a balanced and inclusive energy future for Malaysians. The share of coal-fired power generation in Malaysia is expected to decline gradually as existing plants reach the end of their operational life. No new CFPPs will be built, and with this approach, coal is expected to be almost completely phased out by 2045. "Importantly, the transition is being guided by principles of fairness and inclusivity," Dr. Norasikin emphasized, "with initiatives in place to support collaboration and workforce reskilling, ensuring affected workers have opportunities in the growing clean energy sector."

In parallel, Malaysia has set a national goal to reach net-zero greenhouse gas emissions by 2050. “TNB plans to cut its direct (Scope 1) carbon emission intensity by 35% by 2035, using 2020 as the baseline year,” she highlighted, adding that “the company is also committed to achieving net-zero emissions by 2050.” These targets reflect TNB's role in driving Malaysia's low-carbon energy transition and aligning with global climate commitments through cleaner operations and sustainable energy investments.

2.2.2 Readiness for Early Retirement and Key Transition Challenges

In 2022, Malaysia's total power generation capacity reached 39.5 GW. Gas-fired plants comprised the largest share at 42%, followed by coal at 33% and hydro at 16%. However, even though there are more gas plants, coal still plays a bigger role in electricity production. This is because coal plants run more consistently and at higher output levels; on average, they operated at 74% of their capacity between 2014 and 2022, compared to just 50% for gas plants.

TNB Genco highlighted that while plans for coal phase-out are advancing, each asset's lifecycle and investment structure must be factored in. The Jimah East Power (JEP) plant, with an expected lifespan of 19 years, and TNB Janamanjung, with units ranging between 5 and 15 years, reflect different readiness levels for early retirement. The financial viability of retiring newer plants ahead of schedule, such as JEP commissioned in 2019, is more challenging due to outstanding capital commitments and financing structures, including joint ownership (70:30) with 3B Power Sdn Bhd.

Alongside plans to expand renewable energy, the National Energy Transition Roadmap (NETR) also supports the development of technologies to reduce emissions from existing power plants. According to Assoc. Prof. Dr. Norasikin Ahmad Ludin, "Malaysia's energy transition will not only rely on renewables but also CCS, co-firing of ammonia and biomass, and blending hydrogen with natural gas to reduce emissions from existing power plants."

BloombergNEF (2025) highlighted that Malaysia's energy transition will not rely solely on renewable energy. It will also involve technologies such as carbon capture and storage (CCS), using biomass and ammonia with coal, and blending hydrogen with natural gas to reduce emissions from existing power plants. As Malaysia works towards its climate targets, it must ensure that the energy system continues to deliver reliable and affordable electricity. This report examines the cost of generating electricity, which is referred to as the levelized cost of electricity (LCOE) across key technologies in Malaysia, including solar, wind, combined-cycle gas turbines (CCGTs), and coal. It also reviews the financial viability of using co-firing, fuel blending, and CCS to decarbonize Malaysia's existing coal and gas power station fleet.

The current energy transition must carefully balance three key priorities – energy security, affordability, and sustainability, often referred to as the energy trilemma. Achieving this balance is essential to build a resilient and sustainable energy system. As economies move towards a low-carbon future, investing in renewable energy presents a strong opportunity to address all three areas. Renewables can help meet rising energy demand, improve energy security by diversifying supply sources, and ease the economic pressures linked to fuel imports. “The transition must ensure that electricity remains affordable and reliable while moving towards sustainability,” Dr. Norasikin emphasized.

However, managing the phase-out of fossil fuel plants brings challenges. Decommissioning plants is expensive, involving costs related to debt, equity, workforce payments, and compensation for early closure. “Decommissioning coal plants is expensive, involving costs related to debt, equity, workforce payments, and compensation for early closure,” Dr. Norasikin explained. Many plants may have to reduce their operating hours or shut down earlier than planned to align with global climate goals, turning them into stranded assets facilities that become liabilities before their expected economic life ends. “This is why the transition must be gradual and well-coordinated, to avoid creating new vulnerabilities while solving old ones,” she added.

2.2.3 Economic and Financial Barriers

One of the primary economic challenges hindering the early retirement of coal power plants in Malaysia is the substantial cost associated with decommissioning these facilities (Tenaga Nasional Berhad, 2023). This includes not only the technical and logistical expenses of safely dismantling large-scale infrastructure but also the financial implications of managing stranded assets and compensating for lost capacity. Given that many of Malaysia's existing coal plants were built under long-term Power Purchase Agreements (PPAs), early closure also involves complex contractual obligations and potential financial penalties. These cost-related constraints make it difficult to justify early retirement from an economic standpoint, despite the country's broader commitment to a low-carbon energy transition. Retiring a coal plant before the end of its expected operational life involves significant expenses, not just for dismantling the plant itself but also for site clean-up, environmental management, and settling outstanding obligations with employees and suppliers.

Coal-fired power plants owned by TNB Genco – Jimah East and Manjung were often designed to operate for 30 years or more, with significant capital investments front-loaded at the start. Closing them early means absorbing these costs without the benefit of continued revenue to offset them. "Retiring a coal power plant early comes with some tough economic challenges," noted Assoc. Prof. Dr. Norasikin Ahmad Ludin. "There are decommissioning costs, lost revenue, obligations to shareholders and investors, plus the disruption of supply chains and the need to support workers and local communities." Without specific financial support or incentives, owners face a significant financial burden discouraging them from pursuing early retirement.

The most significant financial risk for plant owners if the coal plant is retired early is the loss of investment returns (Tenaga Nasional Berhad, 2023). When owners invest in building and operating a coal-fired plant, they structure their

financial planning around expected cash flows over the plant's full life span. Cutting the plant's life short means that many anticipated profits will never materialize. This leaves owners unable to recover the full value of their initial investment, potentially leading to major financial losses. This loss is even greater for recently built plants such as Jimah East, with an expected lifespan of 19 years. "One of the biggest concerns is the loss of investment returns," Dr. Norasikin added. "There is also the devaluation of plant assets and potential disruption of long-term financial contracts such as Power Purchase Agreements." These risks make it financially challenging for owners to agree to early closure unless there are clear mechanisms for compensating lost returns.

Plant owners face A major financing challenge when transitioning from coal to renewable energy: the difficulty of securing loans for new renewable energy investments (World Economic Forum, 2023). Shifting from a proven, revenue-generating coal asset to a newer, less familiar renewable energy project presents a financing hurdle. Banks and investors may view renewable projects as carrying higher risks, especially if the owners still have outstanding debts linked to the coal plants. "Plant owners face major issues getting loans for renewable projects," explained Dr. Norasikin. "Banks may still view coal as more stable and are hesitant to back newer technologies, especially for owners without a strong renewable energy track record." Although green financing options are growing in Malaysia, access to affordable and large-scale funding for renewable projects remains limited. As Mr. Dhana noted, most plant owners in Malaysia operate diversified portfolios that include coal, gas, and RE, and transitions require replacing installed capacity and addressing PPAs and baseload generation. Solar, the main RE option in Malaysia, presents additional challenges due to land requirements and intermittent supply. These factors add to the financing complexity and reduce investor confidence.

Existing financial instruments are available to help coal plant owners manage early retirement, such as green bonds, climate financing schemes, and targeted funds such as the Energy Transition Mechanism (ETM) (Chow, 2023).

TNB Genco explicitly highlighted the availability of the ETM as a current financing tool. Additionally, Malaysia offers instruments such as sustainability-linked bonds and the Green Technology Financing Scheme (GTFS), which provides interest rate reductions and partial loan guarantees for green projects. “However, accessing these funds can be challenging due to strict eligibility criteria and complex application processes,” said Dr. Norasikin. She added that “financing often covers only a portion of the investment, and adapting to these models can be difficult for plant owners used to conventional financing methods.” As a result, even when tools are available, they are not always accessible or sufficient to catalyze large-scale transitions.

Government-backed guarantees are among the most effective solutions to mitigate financial risks for plant owners in transitioning from coal to renewable energy (Ministry of Economy, 2023). “These guarantees can assure banks and investors that the project is safe, making it easier to get funding,” Dr. Norasikin explained. Risk-sharing arrangements, climate insurance, clear and consistent long-term policy signals, and advisory support for navigating complex financial frameworks are also essential. These measures reduce uncertainty for plant owners and financiers, making clean energy projects more viable. In Malaysia, such targeted support is vital to overcome institutional and market barriers and build confidence among plant owners, investors, and communities in the just transition pathway.

2.2.4 Incentives for Coal Plant Owners

In Malaysia, measures such as the Green Investment Tax Allowance already help companies offset part of their renewable energy project costs, making these investments more financially viable (Malaysian Green Technology and Climate Change Corporation, 2022). TNB Genco further noted that tax credits, performance-based incentives, and low-interest loans or grants are critical levers for motivating plant owners to shift from coal to renewables. Expanding such support specifically for coal transition projects would give plant owners

such as Jimah East or Manjung a clearer financial reason to move away from coal. Dr. Norasikin emphasized, "If plant owners feel supported and see a real financial benefit, they will be more willing to invest in clean energy." By improving project returns and easing the initial financial burden, tax incentives, and grants can tip the balance towards cleaner energy, helping the country meet its climate goals while making the transition more attractive and realistic for plant owners.

Investors could be incentivized to fund the transition of a coal plant to renewable energy by reducing their risk exposure through government-backed schemes. Investors typically weigh risks very carefully, and many still perceive renewable energy projects, especially those tied to decommissioning large coal assets, as uncertain or complex. According to TNB Genco, guaranteed returns from renewable energy investments and reduced risk through government-backed schemes are effective tools. Dr. Norasikin elaborated that "government-backed guarantees or co-investment from public funds can make renewable projects more attractive." By offering government guarantees that back a portion of the loans or ensure a minimum return on renewable energy investments, Malaysia could make these projects far more attractive to private financiers (Sustainable Energy Development Authority Malaysia, 2021). Risk reduction measures such as partial credit guarantees, interest subsidies, or revenue assurance mechanisms give investors the confidence to channel funds into transition projects. This approach would encourage commercial banks, asset managers, and institutional investors to invest in repurposing coal sites, knowing that part of their capital is protected and the government stands behind the transition effort.

Local and international investment funds can play a pivotal role in financing the transition of Malaysia's coal-fired power plants to renewable energy. Among the key instruments available domestically is the Green Sukuk issued under the Sustainable and Responsible Investment (SRI) Sukuk Framework,

which TNB Genco has identified as an important tool to support clean energy development. In fact, green sukuk has emerged as a critical instrument for financing Malaysia's energy transition. These Shariah-compliant bonds are designed to fund environmentally beneficial projects such as renewable energy while adhering to Islamic finance principles. Thas Thaker et al. (2025) state that “green sukuk support initiatives such as renewable energy, energy efficiency, sustainable transportation, and climate resilience, aligning ethical finance with global sustainability goals.” Despite challenges such as high transaction costs and regulatory inconsistencies, Southeast Asia's green sukuk market, particularly Malaysia's, has seen growing traction, with ESG sukuk reaching USD 44.6 billion globally by Q3 2024. Opportunities exist to strengthen this market through blended finance, robust third-party verification, and government support such as tax incentives and subsidies. These efforts can attract Shariah-compliant and non-Shariah-sensitive investors, providing much-needed capital to enable early coal retirement and green project development.

Malaysia has increasing opportunities to leverage international financing mechanisms to support the early retirement of coal-fired power plants and accelerate the shift to renewable energy. Programmes such as the Asian Development Bank's Energy Transition Mechanism (ETM) and the Climate Investment Funds' Accelerating Coal Transition (ACT) initiative are designed to provide financial support for countries transitioning to low-carbon energy. Dr. Norasikin added, “Malaysia has access to green financing programs through Bank Negara Malaysia and international climate funds such as the Green Climate Fund.” These programs offer a mix of concessional loans, grants, and technical assistance to reduce the financial risks associated with such transitions. Malaysia could also explore participation in Just Energy Transition Partnerships (JETPs), similar to those established in Indonesia and Vietnam, which combine public and private finance for large-scale energy shifts. Locally, Malaysia's Green Technology Financing Scheme and the growing green sukuk

(Islamic green bond) market offer accessible financing for renewable energy projects. State investment arms such as Khazanah Nasional and government-linked pension funds are increasingly aligning their portfolios with sustainability goals, meaning domestic capital is also available to support energy transition initiatives. However, Dr. Norasikin pointed out that “many plant owners may not know how to access these funds or meet the strict requirements.” With better guidance and support, these funds could play a big part in making the transition easier and faster. These funding sources create a strong foundation for making the shift from coal to renewables financially feasible for plant owners.

In Malaysia, carbon markets and pricing mechanisms are increasingly important in shaping the financial decisions of coal plant owners, particularly as they assess the economic viability of continuing coal operations versus transitioning to cleaner energy alternatives. Mr. Dhana noted that “currently there is none,” but this could change with implementing Malaysia's carbon pricing framework. TNB Genco added that “the established price of Carbon Tax or Emission Trading System (ETS) and exception mechanism for the stated coal plants will also determine the continuity of the plant.” Dr. Norasikin explained, “If there is a price to pay for every ton of carbon released, running a coal plant becomes more expensive over time, making renewable energy a smarter and cheaper option in the long run.” If Malaysia strengthens its carbon pricing policies or participates more actively in global carbon credit markets, plant owners could benefit from emissions reductions, turning environmental responsibility into financial gain.

2.2.5 Energy Security and Infrastructure

One of the key energy security concerns in Malaysia related to the early retirement of coal-fired power plants is the potential impact on grid stability and reliability (Tenaga Nasional Berhad, 2024). Coal plants serve as baseload generators, providing a continuous and stable supply of electricity to the grid

regardless of weather conditions or time of day. Premature retirement of major facilities such as Jimah East or Manjung, without adequate replacement capacity, could lead to power shortages during periods of peak demand or in the event of unexpected supply disruptions. While Malaysia is expanding its renewable energy capacity, sources such as solar and wind are inherently variable, relying on sunlight and wind availability. Without robust backup systems, such as battery storage, grid interconnections, or flexible gas peaking plants, where these renewables cannot ensure a consistent and uninterrupted electricity supply. This presents a significant challenge for energy planners seeking to balance decarbonisation goals with the need to maintain a secure and reliable power system. “Retiring a coal plant early in Malaysia raises real concerns about energy security,” warned Dr. Norasikin Ahmad Ludin. “One major worry is grid stability – coal plants provide a steady, reliable power supply, and removing them too soon might cause disruptions, especially during peak demand or bad weather.”

TNB Genco emphasized that energy security must remain a priority in the transition. Key considerations include grid modernization, growing electricity demand, and connecting new renewable energy projects to the national grid. In addition, TNB Genco highlighted the need to enhance grid resilience and improve customer service capacity to support system stability. According to Mr. Dhana, “Accelerating solutions to manage intermittency and short generation duration of solar, such as large-scale battery storage and pumped hydro is essential.”

Malaysia's energy infrastructure would need to become significantly more flexible and responsive to accommodate renewable energy following the closure of a coal plant. One important adaptation is investing in grid modernization to manage renewable sources' variability better. This includes upgrading the national grid to handle distributed energy generation where electricity comes from multiple small-scale solar or wind installations rather than a few large power stations. Smart grid technologies, which use digital

systems to balance supply and demand in real time, will be critical. TNB Genco identified Smart Grid technologies and Battery Storage systems as necessary infrastructure enhancements to maintain power quality and ensure smooth integration of renewables. Dr. Norasikin added, “We also need more energy storage systems, such as batteries, to store extra power when the sun shines or the wind blows. Building smart grids can help balance supply and demand better.”

Malaysia must also promote more flexible generation sources such as hydroelectric power, battery storage, or quick-start gas plants that can rapidly adjust output. Demand-side management programs, incentivizing consumers to shift their electricity use to off-peak times, could also help balance the grid. Additionally, “in rural or remote areas, decentralized systems such as mini solar farms could ensure reliable electricity,” Dr. Norasikin noted. Overall, the transition requires a shift from a static, centralized electricity model to a more dynamic and adaptive energy system that can reliably integrate a growing share of renewables.

Additionally, investments in cross-border grid interconnections, particularly through initiatives such as the ASEAN Power Grid, are essential to enhance Malaysia’s energy exchange capabilities and balance supply across the region (Tenaga Nasional Berhad, 2024). Mr. Dhana also suggested that “increasing interconnectivity with neighboring countries via the ASEAN Power Grid and introducing alternative sources of large-scale, stable, reliable baseload electricity such as nuclear” could strengthen long-term energy security. Together, these infrastructure upgrades are essential to ensure that renewable energy can reliably replace coal without compromising Malaysia’s energy security or economic stability.

2.2.6 Social and Workforce Considerations

The early retirement of a coal power plant in Malaysia would directly and indirectly impact local communities, especially those economically linked to the plant's operations. Communities near plants such as Jimah East or Manjung often depend on coal power stations for direct employment and the many secondary jobs they create in transportation, maintenance services, supply chains, and small businesses. Shutting down a plant early could lead to job losses, reduced local economic activity, and a decline in household incomes. "Job loss is the most immediate concern, as many people work directly at the plant or in related industries," noted Assoc. Prof. Dr. Norasikin Ahmad Ludin. Local businesses that depend on the plant's operations may also feel the pinch, and the loss of technical and vocational training opportunities at the plant could reduce local upskilling avenues, as highlighted by Mr. Dhana. Beyond economic effects, communities may also experience social impacts, such as population decline, if workers migrate elsewhere for employment. There is also a psychological dimension: coal plants often form part of a community's identity, and sudden closures can leave a sense of dislocation or loss. Without careful planning, the benefits of cleaner energy could be overshadowed by the hardship felt in communities once anchored around coal.

To mitigate the negative social impacts of early coal plant retirement in Malaysia, a comprehensive set of strategies must be implemented. One of the top priorities identified by the Ministry of Economy (2023) is the development of targeted workforce transition programmes that support affected workers through reskilling, upskilling, and job placement initiatives. These would involve retraining coal plant workers and related industry employees for new roles in the renewable energy sector or other growing industries such as manufacturing, construction, or services. "Reskilling programs for workers can prepare them for new jobs in the renewable energy sector, such as solar or wind energy," suggested Dr. Norasikin. TNB Genco also noted the potential for job reskilling, workforce redeployment, and new investment in sustainable

industries such as battery storage and renewables. Mr. Dhana further recommended that replacement jobs offer comparable job quality and quantity levels, ensuring affected individuals do not need to relocate.

Skill development initiatives and guaranteed placement support or subsidies for employers hiring transitioning workers could significantly ease the shift (Tan, 2024). Economic diversification plans are also important: local governments could promote the development of alternative industries, such as eco-tourism, green manufacturing, or technology services, to replace the economic base lost with coal. In parallel, social protection measures such as temporary income support, reskilling grants, or community investment funds would help buffer the immediate economic shock. “Governments can also provide financial support or transition packages to assist workers and communities during the change,” Dr. Norasikin added. Importantly, involving the local community early in the planning process ensures that solutions are tailored to their needs and that local ownership of the transition plan exists. TNB Genco emphasized that “involving community members in planning for the transition can improve outcomes and build trust.” Malaysia can support a just and inclusive energy transition that leaves no community behind by combining workforce retraining, economic revitalization efforts, and social safety nets.

2.2.7 Policy and Regulatory Barriers

A number of policy and regulatory barriers must be addressed to make the transition from coal to renewable energy smoother for coal plants in Malaysia. One key barrier is the structure of existing PPAs, which often lock plant owners into long-term contracts guaranteeing revenue over 20 to 25 years. These contracts do not easily allow for early closure without significant penalties. Regulatory frameworks also need clearer pathways for decommissioning fossil assets and repurposing infrastructure for clean energy. Moreover, current electricity market designs favor large, centralized power generation rather than distributed renewable energy projects. “Clear and stable renewable

energy policies are crucial to provide long-term certainty for investors and plant owners,” explained Assoc. Prof. Dr. Norasikin Ahmad Ludin also highlighted the importance of simplifying permitting processes and ensuring renewable projects have reliable grid access.

TNB Genco further emphasized the need for “regulatory frameworks that support energy storage and improved carbon pricing mechanisms.” They also noted that effective transition incentives and a more robust national policy infrastructure are necessary for meaningful change. Mr. Dhana pointed out that policies must consider existing PPAs and the need to replace not just installed capacity but also the firm generation that coal provides.

Specific policies could greatly accelerate coal plants' financial and operational readiness to transition to renewables. For instance, introducing a structured Early Retirement Framework where plant owners are compensated through public funds or carbon finance mechanisms could immediately change the economic logic of keeping coal plants running. “Offering tax incentives or grants for renewable energy projects would reduce the financial burden on plant owners,” Dr. Norasikin noted. TNB Genco cited National Climate Change Policy 2.0 (NCCP 2.0) and the Nationally Determined Contributions (NDC) Roadmap and Action Plan as essential policy instruments operationalizing the Paris Agreement domestically. These are further reinforced by the Long-Term Low Emissions Development Strategies (LT-LEDS), which collectively guide Malaysia's ambition to achieve net-zero greenhouse gas emissions by 2050.

In addition, expanding targeted green financing support, such as concessional loans, tax incentives, and competitive bidding for renewable energy capacity—would enable owners to move more quickly. Regulatory mandates requiring utilities to reduce coal dependency gradually could serve as a catalyst for the private sector. “Simplifying regulations and creating a clear roadmap for coal phase-out would send a strong signal to the market and unlock private investment,” Dr. Norasikin added. International regulations, such as climate

accords and emerging carbon market rules, play an increasingly important role in shaping decisions around early coal plant retirement. Agreements such as the Paris Climate Agreement set broad commitments for emissions reduction, and domestic frameworks such as Malaysia's NDCs reflect this ambition. As TNB Genco noted, "international commitments exert influence through access to financing, pressure from global investors, and the need to align with global norms."

Dr. Norasikin added that "carbon pricing makes coal-fired power more expensive, creating a financial incentive for plant owners to shift to renewables." Mr. Dhana further highlighted that mechanisms such as the EU Carbon Border Adjustment Mechanism (CBAM) would incentivize cleaner grids as exporters seek compliance with global carbon benchmarks. Malaysia's participation in global initiatives such as Article 6 of the Paris Agreement could offer new financial pathways for verified emissions reductions linked to early coal closures.

2.2.8 Role of Foreign Investment and International Support

Foreign investment plays a crucial role in financing the transition of coal plants to renewable energy in Malaysia. International investors often bring capital, technical expertise, experience with large-scale renewable projects, and connections to global supply chains. Their involvement is especially critical in bridging the financing gap for expensive infrastructure upgrades, such as building new transmission lines, energy storage facilities, or large solar and wind farms. "For example, international companies such as Google and Shell have already invested in renewable energy projects in Malaysia," noted Dr. Norasikin Ahmad Ludin, "bringing in both capital and advanced technology." This helps make the transition more affordable while boosting job creation and economic growth in the clean energy sector.

Foreign investment also helps diversify funding sources beyond domestic banks and reduces the burden on public finances. TNB Genco noted that “foreign investment and international support play a role in areas where domestic financial capacity may be limited, such as debt refinancing or mechanisms for repurposing coal assets.” Access to international capital markets and green investment funds is vital for ensuring Malaysia’s energy transition happens at the necessary scale and speed, particularly when decommissioning large coal plants such as Jimah East or Manjung. As Mr. Dhana pointed out, “investment will be required not just to finance the early retirement of the plant but also to finance suitable alternatives to replace the lost generation with cleaner alternatives.”

Several international climate finance initiatives are highly relevant to Malaysia’s transition from coal plants to renewable energy. The Green Climate Fund (GCF) offers grants and concessional loans for low-carbon and climate-resilient development, which could help cover early retirement costs and renewable energy deployment. TNB Genco also identified GCF as a key mechanism. The Asian Development Bank’s Energy Transition Mechanism (ETM) provides funding specifically to buy out and repurpose coal assets, while the Climate Investment Funds’ Accelerating Coal Transition (ACT) program offers technical and financial support. Dr. Norasikin further highlighted that “the World Bank has supported Malaysia’s solar energy projects, providing both funding and technical expertise,” the International Finance Corporation (IFC) also provides blended finance solutions that combine concessional funding with private capital. Therefore, engaging with these global initiatives is essential to unlocking the resources needed for a successful and just transition.

Foreign investors can be incentivized to support the early retirement of coal plants in Malaysia by offering guarantees or risk-sharing mechanisms. Investment in coal-to-renewables transitions carries inherent risks, such as policy changes, technical challenges, and revenue uncertainties. According to TNB Genco, “guaranteed returns from renewable energy investments and

reduced risk through government-backed schemes” are effective levers. Dr. Norasikin elaborated that the “government could provide financial guarantees to ensure that investments in renewable energy projects are secure, even if market conditions are unstable.” A stable and transparent policy environment and tax incentives or low-interest loans make such projects far more attractive to global financiers.

However, attracting foreign investment for coal-to-renewables transitions in Malaysia is not without challenges. Regulatory uncertainty remains a significant barrier: Investors need clear, long-term energy policies that signal sustained government support. “If rules or incentives keep changing, it becomes risky for them to commit long-term funding,” Dr. Norasikin explained. Mr. Dhana added that the absence of strong risk mitigation tools, such as green insurance or government-backed guarantees, can further deter foreign investment. In addition, concerns over the return on investment in renewable energy—particularly in comparison to traditional fossil fuel projects—create hesitation. A consistent, clean energy roadmap and well-communicated policy signals are needed to strengthen investor confidence.

Learning from foreign transition experiences could offer valuable lessons for Malaysia. Dr. Norasikin noted, “Germany’s coal phase-out offers a strong model, where long-term policy timelines were combined with compensation for plant owners and workers.” Countries such as South Korea and South Africa provide further examples of how green bonds, carbon credits, and stakeholder inclusion can facilitate equitable transitions. “Malaysia is also interested in how decommissioning is planned and managed—not just closing the plant but safely handling the site and ensuring workers are supported,” she added. Mr. Dhana pointed out that foreign cases can guide “technology transfer to improve grid capacity for more intermittent renewables, large-scale storage solutions, and alternative baseload sources.”

3. Review of Government Policies

3.1. Policy Overview

Malaysia has established a comprehensive policy framework to guide its transition from coal to renewable energy. Central to this is the National Energy Transition Roadmap (NETR), which outlines the country's commitment to phasing out CFPPs by 2044 and achieving net-zero emissions by 2050. The NETR aims to increase the share of renewable energy in the national power mix to 70% by 2050, emphasizing solar energy as a key component. Complementing the NETR is the National Energy Policy 2022–2040, which focuses on enhancing energy security, affordability, and environmental sustainability. Additionally, the Green Technology Master Plan (2021–2030) provides strategic direction for integrating green technologies across various sectors, including energy, transportation, and manufacturing. These policies underscore Malaysia's dedication to a just and equitable energy transition.

3.2. Policy Evaluation

While Malaysia's policy initiatives demonstrate a strong commitment to transitioning away from coal, their effectiveness in incentivizing coal plant transitions presents a mixed picture. On the positive side, the government's decision to halt the construction of new CFPPs and its clear timelines for phasing out existing ones provide a strong policy signal. Financial incentives, such as the Green Investment Tax Allowance and the Green Technology Financing Scheme, have promoted renewable energy projects. However, challenges persist. The existing PPAs with coal plant operators often lack flexibility, making early retirement of these plants financially unviable without incurring significant penalties. Furthermore, while policies exist to support renewable energy adoption, there is a need for more robust mechanisms to facilitate the decommissioning of coal plants and the retraining of affected workers. The current regulatory environment also requires enhancements to streamline the approval processes for renewable energy projects and to ensure grid readiness for increased renewable integration.

3.3. Key Factors for Policy Enhancement

First, revising existing PPAs to incorporate clauses that allow for the early retirement of coal plants without substantial financial penalties would provide greater flexibility to plant owners. Introducing a structured Early Retirement Framework, supported by public funds or international carbon finance mechanisms (such as the Energy Transition Mechanism), could further incentivize decommissioning. As highlighted by TNB Genco and Dr. Norasikin, such frameworks must be backed by predictable policy signals and adequate compensation mechanisms to reduce resistance from utilities bound by long-term contracts.

Second, expanding green financial instruments, such as Green Sukuk under the SRI Sukuk Framework, climate-linked bonds, and concessional loans, can help attract domestic and international investment. Establishing a dedicated Just Energy Transition Fund would further support retraining, reskilling, and income protection for workers and communities affected by early closures. This fund could also co-finance battery storage, grid modernization, and local economic diversification in coal-dependent areas.

Third, regulatory frameworks should be enhanced to expedite the approval and rollout of renewable energy projects. This includes simplifying permitting processes, strengthening grid access policies, and establishing clear guidelines for repurposing coal infrastructure. A priority should also be the operationalization of smart grid technologies and energy storage, as identified by TNB Genco and Mr. Dhana, to address the intermittency of renewables and protect energy security.

Fourth, aligning national policies with international climate commitments, such as the Paris Agreement, the NDC Roadmap and Action Plan, and the Long-Term Low Emissions Development Strategies (LT-LEDS), will bolster Malaysia's credibility and unlock access to global climate funds. Participation in

international carbon markets, including future frameworks under Article 6, could offer new revenue streams from verified emissions reductions. As noted by Mr. Dhana, instruments such as the EU's Carbon Border Adjustment Mechanism (CBAM) also add external pressure to decarbonize the grid in alignment with global trade standards.

Lastly, continuous stakeholder engagement, including local communities, foreign investors, plant owners, and civil society, is essential to ensure an inclusive, socially just, and politically feasible energy transition. Drawing on international best practices from Germany, Indonesia, and South Africa, Malaysia can design a coherent, locally adapted coal phase-out strategy that is both economically viable and socially fair.

4. Reporting and Recommendations

4.1. Summary of Findings

The survey and policy analysis reveals that while Malaysia has taken important steps toward a just transition from coal, significant implementation and coordination gaps could slow progress. Policies such as the National Energy Transition Roadmap (NETR) and the National Energy Policy (2022–2040) provide a strong strategic direction, including clear targets for coal phase-out and renewable energy expansion. Financial incentives such as the Green Investment Tax Allowance and the Green Technology Financing Scheme (GTFS) have encouraged renewable energy investments. However, they do not yet directly address the economic disincentives and stranded asset risks faced by coal plant owners considering early retirement.

PPAs remain a major barrier, locking utilities into long-term coal generation commitments that make early closure financially unattractive without structured compensation. While Malaysia has begun to tap into international climate finance through mechanisms such as the Green Climate Fund, the Energy Transition Mechanism (ETM), and the SRI Green Sukuk, persistent

regulatory bottlenecks, limited grid readiness, and institutional complexities continue to impede the scale and pace of renewable energy project deployment.

On the social front, while national policy documents acknowledge the importance of workforce retraining and addressing community impacts, dedicated transition programmes and structured reskilling pathways in Malaysia remain largely underdeveloped. Stakeholder engagement, particularly involving plant workers, local communities, and civil society organisations, has not yet been fully institutionalised within the energy transition process. At the international level, frameworks such as the Paris Agreement, carbon pricing instruments, and the European Union's Carbon Border Adjustment Mechanism (CBAM) offer opportunities that remain underutilised. With effective integration supported by clear regulations, robust investor protection, and accelerated energy infrastructure upgrades, these tools could significantly enhance Malaysia's transition strategy, making it more financially sustainable, socially inclusive, and aligned with global decarbonisation objectives.

4.2. Recommendations

Several actionable recommendations emerge to accelerate Malaysia's transition from coal while ensuring a just and financially sustainable shift. First, economic policies should be restructured to provide direct financial incentives for early coal plant retirement. This could include the establishment of a National Just Transition Fund, managed under the Ministry of Finance, and financed through a mix of green sukuk, climate adaptation funds, and contributions from international climate finance mechanisms such as the Green Climate Fund (GCF) and Asian Development Bank's Energy Transition Mechanism (ETM). Structured compensation schemes could be developed to cover stranded assets, decommissioning costs, and reinvestment in clean energy infrastructure. In parallel, the government should consider revising

long-term Power Purchase Agreements (PPAs), especially those involving Jimah East and Manjung, to introduce clauses that allow for voluntary early retirement without heavy penalties, subject to national energy security assessments.

Second, Malaysia must strengthen its financial ecosystem by expanding the use of green sukuk, transition bonds, and concessional loan facilities specifically earmarked for early coal retirement and renewable energy deployment. These instruments should be supported by government-backed guarantees, possibly through Danajamin Nasional Berhad, to lower investment risk and attract institutional capital. Bank Negara Malaysia could also introduce targeted green finance guidelines for banks to prioritise clean energy financing aligned with the Climate Change and Principle-based Taxonomy (CCPT) framework.

Third, regulatory frameworks must be improved to boost investor confidence. This includes streamlining permitting processes through a one-stop regulatory agency, possibly under Sustainable Energy Development Authority (SEDA) or Energy Commission (ST), clarifying long-term coal phase-out timelines in alignment with the National Energy Transition Roadmap (NETR), and ensuring transparent tariff-setting procedures for renewable projects. Equally critical is embedding workforce transition and community development programmes into national and state-level energy planning. The Human Resources Development Corporation (HRD Corp) can lead initiatives to upskill affected workers, while local councils and state governments can implement economic diversification plans to reduce regional dependence on coal infrastructure.

Finally, Malaysia should position itself to actively engage in Just Energy Transition Partnerships (JETPs) by preparing robust, high-integrity transition plans with support from the Ministry of Economy and Ministry of Natural Resources and Environmental Sustainability (NRES). Developing transparent emissions baselines, investment pipelines, and social safeguards will be key to

accessing carbon transition credits and mobilising blended finance at scale. Collectively, these measures can accelerate coal phase-out, build investor and community confidence, and affirm Malaysia's leadership in delivering an equitable, climate-resilient energy future.

5. Conclusion

Malaysia's transition from coal to a cleaner, low-carbon energy system marks a pivotal step toward achieving its national climate commitments and securing long-term economic sustainability. The early retirement of major coal-fired plants such as Jimah East and Manjung is central to this effort. However, it must be managed carefully to avoid energy insecurity, job losses, and community disruption. A just transition grounded in inclusive planning, financial support, and targeted economic measures is essential to protect affected stakeholders and promote equitable outcomes. Striking the right balance between environmental ambition, energy security, and social equity will be critical to ensuring the success of this transition.

Malaysia must implement a coordinated combination of financial, policy, and regulatory reforms to accelerate coal phase-out. These include flexible compensation schemes, expanded access to green and transition finance, government-backed risk-sharing mechanisms, and streamlined approvals for renewable energy projects. Robust carbon pricing and greater access to international climate finance, such as the Green Climate Fund and Energy Transition Mechanism, can bridge financial gaps. Simultaneously, workforce reskilling, social protection programs, and local economic diversification are vital to ensure that no community is left behind. With strong leadership, strategic investment, and cross-sector collaboration, Malaysia can turn this transition into a catalyst for sustainable growth, energy resilience, and global competitiveness.



Economic and Financial Pathways for Accelerating Coal Power Plant Transition: Evidence from Pakistan

Executive Summary (Pakistan)

Pakistan is currently facing severe effects of climate change, and scientists are addressing this global issue due to the increased levels of GHGs in our environment, which are connected to emissions primarily generated by the energy sector. In Pakistan, more than half of the energy sector relies on fossil fuel generation plants, which are considered major contributors to CO₂ emissions. This report analyzes the urgent need for Pakistan to transition away from coal-fired power plants, as the expansion of such plants directly conflicts with national climate goals, policies, and international commitments under the Paris Agreement and Sustainable Development Goals (SDGs).

The review of policies in Pakistan initially focused on incentives for private investors to boost power generation, but it did not address environmental concerns. By the time Pakistan began facing significant changes in the regional climate scenarios, policies had shifted toward sustainability considerations and green financing, yet they remained unratified. Recent policies, such as the Alternative and Renewable Energy Policy 2019, National Electricity Policy 2021, and NEECAP 2023–2030, promote the transition from coal to clean resources. However, the lack of coordination between regulatory frameworks and targeted financial incentives has made plant owners hesitant to commit to phasing out pathways.

One of the major barriers cited by experts in the urge to phase out CFPPs is the decommissioning cost and loss of revenue, which addresses financial challenges in Pakistan. Another hindrance to financial support is the associated risks, such as loss of investment returns, which have already been made in the operational coal projects or other projects in the pipeline and being backed by the government of Pakistan and foreign investment. Experts also highlighted an important issue referring that if Pakistan shifts its energy production infrastructure towards alternate renewable resources, then Pakistan needs huge involvement in transmission lines and grid systems because only one renewable resource is not reliable at a time; Pakistan needs other resources beckoned if one resource fails to generate power due to unavailability. CFPPs could be transitioned to renewable energy if tax credits or low-interest loans were granted, along with low production costs only if the energy generated is cheaper than the primitive course of generation. Therefore, such a transition would require huge finance, which would be possible if Pakistan received a healthy foreign investment.

However, recent action plans in Pakistan are working on energy audits and green funding to regulate the standards related to different sectors, as the power sector is one of them. To lower the risks of climate change in Pakistan, the policy-makers need to align the national energy planning reforms with the

climate obligations, supporting the national-level economic barriers and resilience to combat climate feedback and elevating survival rates to pave secure pathways toward a sustainable future.

1. Introduction

1.1 Project Overview

One Pakistan is facing the extreme climatic changes currently. As it is ranked among the top 10 vulnerable climatic nations, Pakistan is facing high frequency of floods, heatwaves, sandstorms and droughts, etc (GOP, 2021). Pakistan key environmental stressors are threatening both public health and national stability. World Health Organization (WHO, 2022) estimates that environmental causes cause over 13 million deaths per year, highlighting the need for sustainable development and international collaboration.

Pakistan's global contribution was less than 1% in regards of GHGs emission, while in the past decade there is a significant rise in this global contribution due expanded consumption of fossil fuel in the energy and industrial sectors (GOP, 2021). By 2019, Pakistan's reliance on the coal (either imported or domestic) has increased significantly, diminishing the country's lower carbon profile (IPCC, 2023). Pakistan is committing to cut 50% of its estimated GHG emissions by 2030 in accordance with the UNFCCC's Paris Agreement, with 15% of that reduction being unconditional and 35% dependent on outside assistance (UNFCCC, 2015). In particular, Goal 7 (Affordable and Clean Energy), Goal 13 (Climate Action), and Goal 15 (Life on Land) of the Sustainable Development Goals are in line with its Nationally Determined Contributions (NDCs), which represent this ambition (UN, 2015).

The use of fossil fuels, especially for power and heating, is a major source of emissions in Pakistan, accounting for over 25% of total GHG emissions as of 2023 (IPCC, 2023). As a result of rapid urbanization, industrialization, and population growth, Pakistan's electricity demand is increasing, and with Asia

predicted to account for half of global electricity consumption by 2025 (IEA, 2023), Pakistan is predicted to follow suit, further emphasizing the urgency of moving to a more resilient, low-carbon energy system.

According to the Germanwatch Climate Risk Index (CRI) (2021) Pakistan is placed eighth, making it one of the nations most at risk from climate change. According to WorldBank (2022) projections, by 2100, the nation's average temperature may increase to between 28.5°C and 33.5°C. About 20% of Pakistan's emissions in 2019 came from coal-fired power, making it a significant contributor. According to the ESCAP (2023), between 2010 and 2020, coal consumption almost quadrupled, rising from 3.4 to 12.6 Mtoe.

Due to devastating weather disasters that caused US\$30 billion in economic losses, Pakistan topped the CRI in 2022 (GermanWatch, 2025). The nation's reliance on coal, primarily through CPEC energy projects, is a major contributing factor. These facilities, which are mostly located in Thar, have contributed to solving energy shortages, but they have also significantly contaminated the air and water, making environmental and public health problems worse (SDPI 2024a).

An estimated 51 million tons of CO₂ will be released yearly in Pakistan due to CPEC's coal growth, hastening ecological deterioration (SDPI 2024b). This pattern emphasizes how urgently Pakistan must switch to renewable energy sources to cut emissions, protect ecosystems, and fulfill its international climate obligations. Therefore, by reviewing the policies of the Power sector and conducting a short survey, this project tried to highlight the economic and financial challenges and incentives available for early retirement of CFPPs in Pakistan.

1.2 Study Objectives

The study aims to comprehend and accelerate Pakistan's coal-fired power plants' transition to cleaner and more sustainable energy sources. One of the

main goals is to find the financial and economic obstacles that coal plant operators face when starting or committing to a phaseout process. Due to the worldwide move toward low-carbon growth, many of these owners who have invested significantly in coal-based infrastructure in recent years now run the danger of asset stranding, debt buildup, and decreasing investor confidence.

The lack of clear regulations and significant government economic incentives exacerbate these financial issues. Although Pakistan has laws encouraging clean energy, such as the ARE (2019), which calls for 60% of the country's energy to come from clean sources by 2030, there has not been any real development. There are insufficient financial models and policy frameworks to support and ease the transition from coal to clean energy on a global scale, particularly for privately held plants.

Furthermore, while renewable projects funded by the government and donors encourage a certain amount of transition, these initiatives are frequently dispersed and not always in line with coal retirement plans. To determine whether institutional gaps still impede implementation, the study will assess how well these clean energy regulations facilitate or promote a just transition.

Another goal is to examine and outline the possibility of incorporating climate finance into Pakistan's energy transition plan. For plant owners, banks, and investors, international climate funds and financing tools such as results-based financing, green bonds, and concessional loans might be a game-changer in closing the economic divide. In accordance with Pakistan's Nationally Determined Contributions (NDCs) and Paris Agreement commitments, the study will evaluate how international institutions' financial assistance might be used to enhance sustainable energy planning.

The study also searches for and assesses broader structural barriers to coal phaseout to achieve these goals. These include financial constraints such as the lack of frameworks that support the reuse of existing assets, legislative

ambiguity regarding the early retirement of coal plants, and the inability to secure affordable financing. By tying these institutional, policy, and economic challenges together, the report aims to offer a rational framework for accelerating a just, profitable, and policy-backed energy transformation in Pakistan.

2. Local Survey and Data Collection

2.1. Interview Setup

To obtain the objectives of this project, we targeted two anonymous CFPPs in Pakistan for a survey. We set up structured interviews with senior executives of two power plants—one from each. Due to time and distance issues, the questionnaires were shared through emails and WhatsApp, while the interviews with both experts were conducted telephonically. The questionnaire comprises 28 questions categorized into seven sections, one of which comprises information about plants and plant owners.

2.2. Data Collection Summary

When considering early retirement, the electricity policies and sovereign risk (for example, government default, unsecured tariff payments, or instability in government-backed agreements) are important as plant owners must adapt if national electricity policies prioritize renewable energy sources over traditional sources. Our discussion revealed that the three most significant challenges in transitioning from coal are delayed payments to power producers by the governments, the existing regulatory/contractual obligations between electricity producers and the government, and infrastructural constraints in the power system and grid due to differences in geographical plant placements. However, it has also been revealed that additional costs due to plant retirements are also the biggest challenge in transitioning. However, among the factors considered when deciding on retirement from coal power plants, the remaining lifespan of the coal-fired power plant and outstanding

loans of power plants are found to be the main factors behind the decision due to the heavy investment already made. Therefore, if the lifespan of the coal power plant remains short, then retirement could be the best strategy. After the completion of one power plant with a production capacity of 1320 MW in 2017, some other power plants with an annual production capacity of more than 5000 MW under the China and Pakistan Economic Corridor (CPEC), based on local and imported coals were also completed and are operational, while the renewable power plants with an annual capacity of less than 3000 MW only under the same CPEC were also installed. Thus, it is observed that Pakistan prioritizes investing more in coal than in renewable sources. However, one expert has emphasized that before 2015, Pakistan produced only 0.2% of its total electricity from coal.

In contrast, China produced 60–70%, the USA produced 35%, and India produced 44% of their total electricity from coal. The contribution of electricity from coal has increased over the last few years, but currently, no trend is seen in investments in coal plants, and future investments are not expected. The local electricity sector is not booming, and existing facilities are not fully operational. It is recommended to first focus on developing the power industry using affordable resources before transitioning to other resources, such as renewable energy.

Regarding the different types of barriers to early retirement, it is found that decommissioning costs, lost revenue from the plant's operation, and impact on financial contracts and PPAs are the main economic barriers that hinder early retirement. In addition to the economic barriers, financial, policy, and regulatory challenges also create barriers to early retirement. The main financial challenge is Difficulty securing loans for renewable investments, as the financial market for green instruments is not fully developed. Additionally, international investors' insufficient knowledge or awareness of available funds and risk perception create barriers to accessing international climate finance or green investments. Despite financial challenges, financial risks exist, such as

loss of investment returns that have already been made in coal projects, devaluation of plant assets, and impact on financial contracts and PPAs. However, experts say financial risk could be mitigated by securing government-backed guarantees and risk-sharing agreements when deciding on early retirement. In addition to these challenges, no specific policies could help accelerate the financial and operational readiness of transition. The main barrier to developing a specific policy related to early retirement could be that renewable energy is not a stable source. However, other factors, such as not having fully developed alternative sources of renewable energy (such as solar, wind, and hydel) and the impact on grid stability and reliability, raise concerns about energy security. Second, improper and inefficient infrastructure for renewable energy could also be a reason for the long-standing dependency on coal power plants, resulting in no policy for early retirement. Another important finding highlighted by one expert during the survey is that capacity payments (provided on a monthly basis without supplying electricity) to coal power plant owners are also a significant factor that discourages early retirement. While the other expert viewed capacity payment contrary to the first expert, the expert emphasized that a misperception prevails about capacity payments and that they are the biggest barrier to early retirement. That is not the case; capacity payments are not exclusive to coal power plants; renewable plants require them, too. Annual maintenance for coal plants, which spans 1-2 months yearly, requires plants to halt production. During this period, capacity payments are financial support to meet operational expenses such as salaries. Similarly, renewable power plants, such as wind plants, do not produce consistent electricity and may not be operational year-round. They also require capacity payments to cover fixed and operational expenses when not generating revenue. Therefore, the impact on financial contracts is considered the main regulatory or policy barrier that must be addressed to make the transition from coal to renewable energy smoother.

The energy infrastructure, including transmission lines and grid, would be important in early retirement. For now, transmission lines have not been upgraded, which cannot sustain electricity, and their conversion ability from alternating current to direct current and vice versa has deteriorated. Thus, there is an urgent need to improve transmission lines since the conductors used have a lifespan of 15–20 years and are never replaced or upgraded. This requires substantial investment, as transmission lines cost at least 50% more than building power plants. Unfortunately, infrastructure development requires significant funding, which is lacking, resulting in at least 70% of the total electricity produced being lost. Therefore, it is recommended that Pakistan first develop a sustainable power industry utilizing available resources, such as local coal, which is cheaper. Second, utilize that electricity at full capacity, minimizing power outages, to generate revenue and develop robust transmission lines before gradually transitioning from coal to renewable energy sources. However, if Pakistan decides to close coal power plants, then dependency on one source of renewable energy would not be sufficient, as the production cycle of energy from renewable sources is intermittent – solar power can only produce energy on sunny days, wind power can produce energy only when wind speeds are reasonable, and hydropower plants can produce more energy during summer, provided water flow is reasonable. Therefore, it is very important to consider all alternate renewable energy sources before retiring from coal. Pakistan is a country that heavily relies on foreign investments and foreign aid. The coal plants operational in Pakistan are also a result of foreign investment. Thus, retirement from coal in Pakistan could be accelerated if funds from other countries and international institutions, such as the World Bank, are successfully secured for renewable energy projects. However, foreign investment will come through the government; hence, it depends on the priority. Attracting foreign investment for a coal-to-renewables transition for early retirement is challenging due to political risk or instability, risk of insufficient return on investment, and regulatory uncertainty. However, it could be possible if Pakistan learns from other countries how they

have devised policies, regulations, decommissioning procedures, and financial incentives to attract foreign investment in the renewable sector. Therefore, by offering guarantees or risk-sharing mechanisms and through a policy framework that supports long-term stability of incentives for foreign investors, early retirement of power plants in Pakistan can be made possible.

The only attraction for investors to opt for transitioning is the low cost of production, as energy from renewable sources is cheaper; however, the heavy investments already made in coal plants trigger investor worries about financial recoveries. Therefore, if international accords or carbon markets placed greater emphasis on each economy, that would be a helpful factor that could facilitate early transitioning. While the transition from coal to renewables would positively impact society, it could also have an adverse effect. Early retirement could lead to unemployment for technical workers in fuel operation and mechanical departments. It is estimated that at least 2000 workers (supporting 2000 families) will lose their jobs due to the transition of this power plant. Second, the Pakistani power sector relies on a load-based system, where transmission lines operate on a ring-based system that is not fully advanced or updated. Line losses will be significant if this power plant undergoes early retirement due to the underdeveloped infrastructure. However, this negative social impact could be minimized with a proper strategy. Existing coal plants could adopt a rotation policy that enables workers to perform diverse tasks. If the transition occurs, technical staff can be reassigned to other departments. Renewable sources are cheaper, enabling renewable plant owners to employ and sustain many workers by offering them work-life balance policies that reduce work burden. Moreover, there should be a mechanism for developing sufficient funds to compensate the 2000 workers who will lose their jobs immediately. Also, by developing infrastructure, specifically transmission lines, the problem of power outages in the community, which would arise due to transitioning, can be prevented.

3. Review of Government Policies

3.1. Policy Overview

Because of the importance of coal in the energy security of Pakistan, at this moment the Pakistani government does not have any concrete policy for coal phase-out. However, there are certain policies and plans were devised over the years for the power sector. Such as, the first significant move to induce private sector involvement in electricity generation from the fossil fuels was the *1994 Electricity Policy*. It was created in response to the rising demand for power and provided generous incentives such as tax breaks, streamlined processes, and foreign exchange safeguards (PowerPolicy, 1994). The *1995 Policy* sought to lower tariffs and boost rural development by promoting hydropower as an inexpensive, domestic alternative (HydroPowerPolicy, 1995). The *1998 New Independent Power Projects Policy* strategy sought to create a competitive electricity market. The program promoted affordable domestic energy solutions and boosted investor confidence by guaranteeing currency convertibility, contract enforcement, and political risk coverage (PowerPolicy, 1998). The goal of the *2002 Power Policy* was to eliminate energy gaps by encouraging private investment in diverse indigenous power-generating resources and environmental sustainability (Policy 2002). Pakistan's first systematic approach to renewable energy was introduced under *Policy for Renewable Energy Development 2006*, which outlined integration goals in phases. Under a low-carbon, inclusive national framework, the policy prioritized creating clean energy, jobs, and social uplift (REPolicy, 2006).

A national plan for climate-resilient development was presented in the *National Climate Change Policy 2012* (NCCP). Planning for the water, agricultural, energy, and health sectors took climate concerns into account (NCCP 2012). The *National Power Policy 2013* prioritized cost, efficiency, and sustainability in response to severe power shortages (PowerPolicy, 2013).

The Power Generation Policy 2015 focused on earlier initiatives by providing more incentives and streamlining project approvals. It prioritized using local

resources, particularly hydropower, and diversifying to provide inexpensive electricity (PowerGenerationPolicy, 2015). The ARE (ALTERNATIVE and RENEWABLE ENERGY) Policy 2019 targets 20% renewable capacity 2025 and 30% by 2030. The strategy gave Pakistan a plan for varied, reasonably priced, and sustainable energy by coordinating renewable development with environmental objectives, economic decentralization, and clean energy availability (ARE 2019).

With an emphasis on affordability, dependability, and sustainability, *National Electricity Policy* (NEP) 2021 brought Pakistan's energy agenda into line with international climate obligations (NEP, 2021). As per the Paris Agreement, this *National Climate Change Policy* (NCCP) was updated in 2021 and broadened its focus to include adaptation and mitigation (NCCP 2021). Under *Updated Nationally Determined Contributions 2021*, Pakistan's revised NDC pledges to cut 50% of its estimated 2030 emissions, with 35% dependent on international assistance and 15% unconditional. The plan calls for a 30% EV adoption rate, a coal moratorium, and an increase in renewable energy to 60% of total energy by 2030 (UpdatedNDCs 2021).

Pakistan's strategy plan to lower energy intensity and encourage sustainable, effective energy use in all sectors is outlined in the *NEEC 2023 & Electricity Action Plans 2023*. In line with SDGs 7 and 13 and the Paris Agreement, the strategy addresses high energy losses, growing demand, and reliance on fossil fuels (NEEC 2023). Pakistan's strategy framework for ensuring affordable, safe, and sustainable power is the National Power Plan 2023–2027. Its six main objectives—diversification, self-sufficiency, affordability, financial viability, resilience, and sustainability—are backed by 20 specific action areas (NEP 2023–2027). The Ministry of Energy's AEDB in Pakistan created the strategic national roadmap known as *National Energy Efficiency and Conservation Action Plan (NEECAP) 2023–2030* to promote energy efficiency and conservation (EE&C) in all sectors. The strategy aligns with the SDGs and the Paris Agreement and intends to cut 10.7 million tons of CO₂ emissions and 3 million TOE in energy usage by 2030 (NEECAP 2023–2030).

3.2 Policy Evaluation

A slow but noticeable change in priority is seen in the evolution of Pakistan's power sector policy environment, particularly with regard to coal-based power and its transition. All fuel types, including imported coal, were initially accepted as feasible solutions to the nation's expanding energy needs by laws such as the Electricity Policy 1994 and the Power Generation Policy 2015. By providing substantial financial and fiscal incentives, foreign exchange protections, and streamlined regulatory frameworks, these measures effectively encouraged the private sector to enter the market. Though it successfully drew in short-term investment, the careless use of imported coal also created a long-term reliance on expensive, environmentally harmful energy supplies, which increased Pakistan's circular debt and external vulnerabilities.

Early policies effectively closed energy gaps and lured private investment, but they were unsustainable because they lacked lifecycle cost analysis and environmental foresight. Pakistan has recently concentrated on planning for cleaner generation, grid upgrading, and varied sources, primarily through the Electricity Policy 2021 and NEECAP 2023–30. The most recent frameworks strongly emphasize financial risk mitigation, integrated planning, and local resource utilization—areas where earlier policies had fallen short.

However, there are still difficulties. Even though coal has been deprioritized by more recent legislation, legacy projects backed by earlier agreements still exist. High upfront costs for renewables, limited local production of clean technologies, and regulatory inertia all contribute to the slowdown of transition efforts. Strong support mechanisms for retiring or repurposing existing plants are now required to close the policy gap created by the phaseout of previous coal subsidies. However, the policy environment is becoming increasingly sensitive to energy decarbonization, indicating a maturing governance system that strikes a compromise between climate commitments and economic development.

3.3 Key Factors for Policy Enhancement

Policy changes must address key structural and economic deficiencies to strengthen Pakistan's transition from coal-fired power generation to a cleaner, more ecologically sound energy future. Prior policies frequently did not distinguish between high-emission and low-emission technologies, even if they successfully encouraged private investment through extensive fiscal and financial incentives. Unintentionally, this lack of focused incentives increased dependency on imported coal and other carbon-intensive fuels. Going forward, governments must incorporate tools such as environmental taxes or carbon pricing to discourage polluting energy sources while providing green tax credits or performance-based subsidies to hasten the adoption of renewable energy sources.

Another significant gap is the lack of clear exit plans for the current coal infrastructure. To facilitate a smooth transition, future regulations should specify decommissioning pathways, including repurposing procedures and financial packages for coal plant retirement or conversion. Concessional finance tools must also be established, especially for distributed generation and domestic clean resources such as small hydro, wind, and solar. To cut costs and increase long-term capacity, support for domestic production of clean energy technologies, including eliminating intermediate goods taxes and venture capital access, will be crucial.

It is also critical that federal and provincial officials coordinate more clearly. It is still challenging to match incentive systems with local-level implementation, as recent policy frameworks such as the National Electricity Policy 2021 and the NEECAP 2023–30 demonstrate. Investor trust will be increased by strengthening institutional responsibility, standardizing the license and tariff approval procedures, and incorporating transparency into competitive bidding. Lastly, the energy transition may be made both technically sound and economically and socially sustainable by including climate-linked financial instruments such

as green bonds, MRV-aligned subsidies, and risk assurances through public-private partnerships.

4. Reporting and Recommendations

4.1 Summary of Findings

This report provides crucial insights into Pakistan's transition from coal to clean energy based on a comprehensive analysis of national energy policy and survey data from experts in coal-fired power plants. The findings indicate that Pakistan continues to confront significant financial, legal, and infrastructure challenges that delay the retirement of coal-fired power facilities, despite increasing climate threats and international pressures. While plant owners acknowledge the long-term economic advantages and environmental imperatives of transitioning to renewable energy, experts recommend that the government should prioritize developing the power sector before shifting toward green energy infrastructure. The survey revealed that immediate financial risks, such as high decommissioning costs, potential long-term revenue losses, and stringent contractual obligations with the government, are key obstacles.

One important factor influencing retirement decisions is the remaining lifespan of coal plants. Experts indicated they would be open to retiring early, provided that appropriate financial incentives, tax breaks, or refinancing options were made available. Notably, capacity payments, which are guaranteed monthly payments to plant owners regardless of the dispatch of electricity, were found to be a potent restraint against early closure, says the expert. In contrast, other experts say capacity payments are often mistaken for the main obstacle preventing coal plants from retiring early. In actuality, renewable energy projects also receive similar incentives, and therefore, these are not exclusive to coal-fired power stations.

Inadequate infrastructure was also noted as a major obstacle in the study. Pakistan's underdeveloped transmission lines, grid system, and renewable integration capabilities raise questions about energy security if coal is phased out without a concurrent grid upgrade. One senior expert suggested that CFPPs require an annual maintenance session of about 1-2 months, during which the plant is temporarily shut down. Additionally, another issue with power transmission is that the conductors installed in the transmission lines need to be replaced every 15-20 years. In contrast, in Pakistan, they have never been replaced since their installation, leading to the loss of approximately 70% of the generated power within the lines. The interviews also highlighted the inherent variability of renewable energy output, which necessitates a combination of clean sources such as wind, solar, and hydropower to ensure supply stability, considering that renewable power plants do not generate power consistently throughout the year.

Regarding policy, the investigation verified that previous frameworks did not distinguish between polluting and clean technologies and instead strongly encouraged capacity growth and foreign investment through alluring fiscal incentives. Long-term reliance on imported coal was brought about by policies such as the Power Generation Policy of 2015 and the Electricity Policy of 1994, which increased circular debt and made the economy more vulnerable. A shift toward sustainability is seen in more recent initiatives, such as the ARE Policy 2019, National Electricity Policy 2021, and NEECAP 2023–2030, which emphasize green financing, energy efficiency, emission reduction commitments, and the procurement of renewable energy.

Despite these advancements, the way policies have been implemented has been inconsistent. There are also unresolved issues with limited financial models to enable repurposing or decommissioning, unclear departure arrangements for operational coal projects, and coordination gaps between federal and provincial entities. The study also emphasizes how crucial

institutional changes, targeted incentives, and public sector leadership are to removing these structural barriers.

4.2 Recommendations:

First, we identified that the Pakistan does not have any specific policy or plan for coal phase-out. However, these are what we recommend to Pakistan and to other countries that have similar structure and energy portfolio like Pakistan that the must devise a concrete plan for the early retirement of CFPPLs. Practical changes in economic policy must immediately address concerns raised by investors, plant owners, and institutional stakeholders if Pakistan is to hasten its move away from coal. The first step is to create a well-organized coal exit roadmap, which lacks in Pakistan, with precise deadlines that encourage early coal plant retirement through buyback programs, tax breaks, and focused debt restructuring. Government-backed transition funds or compensation plans can reduce financial risks associated with plant owners switching to cleaner technology. Before gradually switching from coal to renewable energy sources, maximize electricity use to lower power interruptions, boost income, and improve transmission infrastructure.

Second, low-interest green refinance instruments, such as blended finance and concessional climate loans, should be made available through current financial structures in Pakistan. These tools should be given priority for projects that replace coal-based capacity. Early-stage investments in renewables, particularly in off-grid and industrial applications, would be financed by creating a Clean Energy Transition Fund, which public resources and multilateral organizations would back.

Third, the Government of Pakistan could modify its system of fiscal incentives so that they are directly tied to lower emissions. Accelerated depreciation, waivers of customs duties on renewable plant equipment, and performance-linked tax credits should be provided to plant owners switching from coal. In

order to refocus profits toward sustainable operations, carbon-intensive factories should also be subject to progressively rising environmental levies or the elimination of legacy subsidies.

In Pakistan, a comprehensive legislative and regulatory framework incorporating power sector changes with climate goals is also necessary to clarify policy. In the event of a renewable conversion, long-term PPAs in Pakistan should have fuel-switching flexibility and permit pricing restructuring. To expedite land acquisition, tariff approvals, and licensing for sustainable energy projects in Pakistan, the regulatory bodies such as NEPRA and AEDB must cooperate.

Lastly, it will be crucial to provide plant owners, especially public-sector GENCOs (Generation Companies) in Pakistan, with technical support and capacity-building. This includes access to carbon finance markets, communication of global best practices, and assistance with the viability of repowering. For the transition to be sustainable over the long-run, policies if devised by Government of Pakistan, must also encourage the growth of a skilled labor force.

5. Conclusion

According to the report's findings, Pakistan's shift from coal to clean energy is a crucial, although extremely complicated, effort to protect its energy security, economic stability, and climate resilience. The country's over-reliance on coal, especially due to the China-Pakistan Economic Corridor (CPEC), has led to long-term budgetary liabilities, increasing greenhouse gas emissions, and environmental damage. It is more important than ever to phase out coal power and increase renewable energy production, as Pakistan is one of the world's most climate-vulnerable nations.

A key component of this transition process is the role of stakeholders. Plant owners need clear legislative direction, risk-sharing arrangements, and

genuine financial incentives to commit to early plant retirement or fuel-switching methods because they are confronted with capitalized investments and operating hazards. Similarly, politicians and regulators must immediately create coordinated, enforceable exit strategies, fiscal reforms, and tariff structures to encourage investment in clean technologies while maintaining grid stability and safeguarding vulnerable consumer groups.

Accelerating the phaseout of coal offers significant advantages beyond reducing global warming. Switching to a system powered by renewable energy would lessen reliance on imports, stabilize energy prices, prevent the accumulation of cyclical debt, and create jobs by fostering the growth of regional clean-tech sectors. Furthermore, energy security would be enhanced by an integrated, varied mix of renewable energy sources, particularly in isolated and underdeveloped areas. On the contrary, shutting down the CFPPs would also lead to the loss of human capital and the earnings of more than 2000 employees; while programming the phaseout of coal-fired power projects, the government should develop the necessary funds to compensate those 2000 employees and their associated families.

Creating a systematic coal exit roadmap, implementing green finance structures, performance-based tax incentives, and synchronizing national policies with international climate finance opportunities are among the practical measures recommended in this report. A just, accessible, and financially sustainable energy transition depends on strategic investments in grid modernization, renewable energy integration, and human resource development.

In conclusion, Pakistan could navigate towards a durable, low-carbon energy future with the correct mix of financial tools, institutional development, policy changes, and international collaboration. Now is the moment for swift, concerted action to protect the environment and secure long-term economic

growth and social cohesion by devising a concrete policy for the early retirement of CFPPLs.



Empirical Analysis of Interview Results

Methodological Approach

This section presents a thematic analysis of in-depth interviews conducted with two key stakeholder groups: financial institutions and coal power plant owners. A qualitative coding approach was employed using Taguette Software, an open-source software for qualitative data analysis, to code and analyze the interview transcripts systematically. All interview transcripts were first cleaned for accuracy and anonymized, then uploaded into Taguette for coding. Coding followed a thematic framework informed by the structured questionnaire used in the interviews, ensuring that the codes reflected the main topics and issues probed during the conversations. In particular, the questionnaire had distinct sections covering perceived challenges/barriers to early coal retirement and

solutions/enablers for facilitating transition finance; this dual structure was mirrored in the coding scheme. (Rampin & Rampin, 2021)

Two separate Taguette project files were created, one for financial institutions and one for power plant owners, to maintain analytical clarity between the perspectives of these different groups. Within each project, a dedicated codebook was developed, comprising a full list of tags (codes) capturing the themes mentioned by respondents. Each tag corresponds to a specific category of barrier or solution. The tags were chosen based on both the interview guide topics and emergent themes from the data, and each was clearly defined to capture the underlying rationale. Tables 1, 2, 3, and 4 below present the complete list of codes used for financial institutions and power plant owners, respectively, along with a brief description of the rationale for each category.

Table 1: Financial Institutions – Challenges Tags

Tag	Description
Credit Risk	<i>Risk of borrower default or non-payment, especially pertinent if coal assets are retired early or if replacement projects underperform financially.</i>
Data/Reporting Challenges	<i>Difficulties in collecting, verifying, and disclosing reliable ESG data or transition-related performance metrics for projects.</i>
Insufficient Government Incentives	<i>A perceived lack of policy support, subsidies, or mandates from authorities to make transition finance attractive (e.g. absence of clear government push or rewards for financing coal transitions).</i>

Lack of Standard Frameworks	<i>Absence of clear taxonomies, standards, or criteria defining eligible “transition” projects (making it hard to assess what counts as a credible coal-to-clean transition investment).</i>
Limited Pipeline	<i>Shortage of investable, high-quality projects for coal phase-out or clean energy replacement.</i>
Low Bankability	<i>Transition projects seen as financially weak or unattractive under current market or policy conditions.</i>
Operational Risk	<i>Internal constraints within institutions, such as limited staff expertise or structuring capacity to evaluate and execute complex transition finance deals.</i>
PPA Constraints	<i>Inflexible or long-term PPAs that bind coal plants to continued operation and thus hinder early retirement or restructuring</i>
Policy Uncertainty	<i>Unclear, inconsistent, or rapidly changing government policies on energy and climate, which increase the risk of long-term investments in the transition (lack of a stable policy roadmap).</i>
Private Capital Hesitation	<i>Observations that private investors are reluctant to participate in coal transition financing without strong de-risking measures, leading to a financing gap.</i>
Regulatory Barriers	<i>Legal or regulatory constraints such as licensing rules, ownership restrictions, or ongoing fossil-fuel subsidies that complicate the closure of coal assets or the funding of replacements.</i>
Stranded Asset Risk	<i>Concern that investments in coal plants (or associated loans) could become non-performing or lose value due to early closure and obsolescence of the asset.</i>

Technical Expertise Gap	<i>Gaps in knowledge or expertise within financial institutions in structuring and managing coal transition finance transactions.</i>
Unstable Revenue Models	<i>The risk that revenue streams from transition projects may be volatile or insufficient, making the financing models uncertain.</i>

Source: Climate Finance Asia (2025)

Table 2: Financial Institutions – Solutions Tags

Tag	Description
Blended Finance	<i>The use of mixed capital sources (concessional public funds combined with commercial private funds) to de-risk projects and improve their risk-reward profile for investors.</i>
Carbon Pricing	<i>Implementation of carbon taxes, emissions trading systems (ETS), or internal carbon pricing to improve project economics for cleaner energy and penalize continued coal use, thereby incentivizing transition investments.</i>
Government Support	<i>General calls for greater government involvement, such as strong policy coordination, clear transition roadmaps, or public financial support.</i>
Government-backed Guarantees	<i>The introduction of sovereign or public credit guarantees to cover certain risks, thus giving lenders assurance that they will be made whole even if projects underperform.</i>
Impact Tracking Tools	<i>Development of better tools and frameworks (internal or industry-wide) to measure and report the environmental and</i>

	<i>social impacts of financed projects, ensuring transparency and accountability in transition finance.</i>
Innovative Finance Models	<i>New financial instruments tailored to transition contexts (for example, transition bonds, sustainability-linked loans, carbon-linked financing, debt-for-climate swaps) that could mobilize capital in novel ways.</i>
International Collaboration	<i>Engagements with multilateral development banks (MDBs), development finance institutions (DFIs), and global climate funds to co-finance projects or provide technical assistance and concessional funding.</i>
Just Transition Fund	<i>Proposals for establishing dedicated funds (public, private, or blended) to address the social and labor dimensions of the transition, ensuring resources for worker retraining, community support, etc., which in turn can facilitate plant closure deals.</i>
PPPs	<i>Use of public-private partnerships where government and private financiers co-invest in necessary infrastructure or replacement capacity, sharing risks and returns.</i>
Sovereign Guarantees	<i>State-backed assurances to cover project risks and thus lower the risk for private lenders.</i>
Standardized Reporting Frameworks	<i>The need for harmonized standards for ESG and climate-transition reporting, so that investors have reliable information to compare projects and track outcomes.</i>
Subsidies	<i>Direct financial support from government in the form of subsidies, tax credits, or price support mechanisms to improve the financial viability of transition projects.</i>

Transition Finance	<i>The development of financing tied specifically to coal transition outcomes, potentially with incentives such as lower interest rates as targets are met.</i>
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Source: Climate Finance Asia (2025)

Table 3: Power Plant Owners – Challenges Tags

Tag	Description
Access to Capital	<i>Difficulty in obtaining necessary financing for transition efforts due to limited availability of green finance or affordable loans.</i>
Asset Devaluation	<i>The loss of the plant's economic value if retired early – owners fear writing off assets from their balance sheets (stranded assets) and losing expected returns on past investments.</i>
Cost of Retirement	<i>The high upfront expenses associated with decommissioning a coal plant (dismantling infrastructure, site remediation), along with costs such as worker severance and other closure liabilities.</i>
Revenue Loss	<i>Foregone income and profit from shutting a plant down ahead of its intended lifetime; this includes the opportunity cost of lost electricity sales.</i>
Grid and Infrastructure Issues	<i>Insufficient grid capacity or flexibility to integrate replacement renewable energy, plus related infrastructure gaps that make it hard to retire coal plants without risking grid reliability.</i>
Technical Capacity Gaps	<i>Shortages in technical know-how or experience needed to plan and implement alternatives.</i>

Social and Labor Impacts	<i>The local negative impacts of plant closure, especially job losses for plant workers and contractors, as well as potential community economic downturns and resettlement issues, which create resistance to early retirement.</i>
Operational Uncertainty	<i>Uncertainties in the shutdown process, such as the complexity of renegotiating or terminating long-term PPAs, unclear timelines or procedures for retirement approvals, and potential delays in regulatory or tendering processes for new capacity.</i>
Policy and Regulatory Barriers	<i>The lack of clear mandates or supportive policies from the government to retire coal early, along with regulatory hurdles that slow down transitions.</i>
Market Distortions	<i>Market conditions that favor continued coal operation, such as ongoing fossil-fuel subsidies, regulated electricity tariffs or domestic coal obligations, and weak incentives for renewable energy.</i>
Investor Perception Risk	<i>The hesitancy of external investors to get involved with assets or projects linked to coal transitions, because these assets are seen as risky or controversial, making it hard for plant owners to attract new investment for repurposing or refinancing.</i>
PPA Constraints	<i>Contractual obligations from PPAs that lock in coal power supply for long durations or at set quantities, thereby penalizing or outright preventing plant owners from ceasing generation early or switching to alternative energy sources.</i>

Source: Climate Finance Asia (2025)

Table 4: Power Plant Owners – Solutions Tags

Tag	Description
Policy Support and Guarantees	Stronger government actions such as establishing clear coal phase-out policies, providing sovereign guarantees or assurances for transition projects, and enacting supportive reforms.
Public Finance Mechanisms	Financial support from the public sector to cover transition costs such as dedicated transition funds, subsidies or tax credits for shutting down coal capacity, or compensation schemes for lost revenues and asset value.
Private and Blended Finance	Mobilization of private capital through models that mix it with public funding or guarantees. Plant owners acknowledge the need for private investment in replacement infrastructure or remediation, but stress that blended structures are required to make these deals viable.
Climate Finance Access	Access to international climate finance and development aid, including grants or concessional financing from multilateral climate funds, MDBs, or bilateral donors, to support early retirement projects.
Infrastructure Development	Investments in grid modernization and related infrastructure upgrades that would enable more renewable energy to replace coal.
Just Transition Planning	Strategies and resources for mitigating social impacts such as worker reskilling and job placement programs, economic diversification for affected communities, and stakeholder engagement processes.

Source: Climate Finance Asia (2025)

Tables 1, 2, 3, and 4 summarize the coding structure used in Taguette to analyze the interview transcripts. These codes were derived through a combination of inductive and deductive methods, guided by key themes in the literature and preliminary reviews of the data. Tables 1 and 2 capture key challenges and solution strategies from the perspective of financial institutions, while Tables 3 and 4 reflect the views of power plant owners. These tags served as the analytical backbone for identifying stakeholder priorities, shared barriers (such as “policy uncertainty,” “PPA constraints,” and “low bankability”), and recurring solution themes (such as “blended finance,” “government-backed guarantees,” and “just transition funds”). The frequency and context in which these codes appeared in the interviews directly informed the structure and narrative of the empirical findings presented in the previous section.

It is important to note that the coding process was iterative. Initial tags were drawn from expected themes based on the questionnaire and literature on coal transition finance and refined or expanded as new concepts emerged during the interviews.

Analytical Strategy

After coding was completed, the analysis proceeded in two main steps. First, a code frequency analysis was conducted to identify the themes that interviewees most commonly referenced. Essentially, the number of times each tag appeared across all interviews and the number of distinct interviews in which it appeared were tallied for both stakeholder groups. This frequency gives a quantitative sense of salience. For example, which barriers loom largest in the minds of financial institutions versus which are more peripheral. The results of this frequency analysis are visualized in a series of charts, including pie charts that show the share of references for each code and bar charts that highlight the top factors.

Second, a co-occurrence analysis was conducted to examine the interlinkage between different themes. This involved examining instances where two or more codes were applied to the same segment of text or where certain codes tended to appear in the same interview response. Co-occurrence helps in understanding the relationships between issues. For instance, whether respondents who discussed “Policy Uncertainty” also frequently mentioned “Private Capital Hesitation”, suggesting that policy instability might be driving investors’ reluctance, or how often “Grid and Infrastructure Issues” were mentioned alongside “Renewable investment” solutions. These patterns, although assessed qualitatively due to the moderate sample size, provided valuable insights into causal linkages and the clustering of challenges and solutions within stakeholder narratives.

Crucially, responses were grouped by perspective (challenges vs. solutions) during analysis. This means we separately aggregated the frequency of “barrier” codes and “enabler” codes, rather than mixing them, for clear distinguishment. Within each Taguette project, codes were organized thematically into two broad groups. This dual grouping allowed for comparison not only of which challenges were most prevalent, but also of which solutions were most commonly suggested, and to see if the solutions aligned with the most pressing challenges identified.

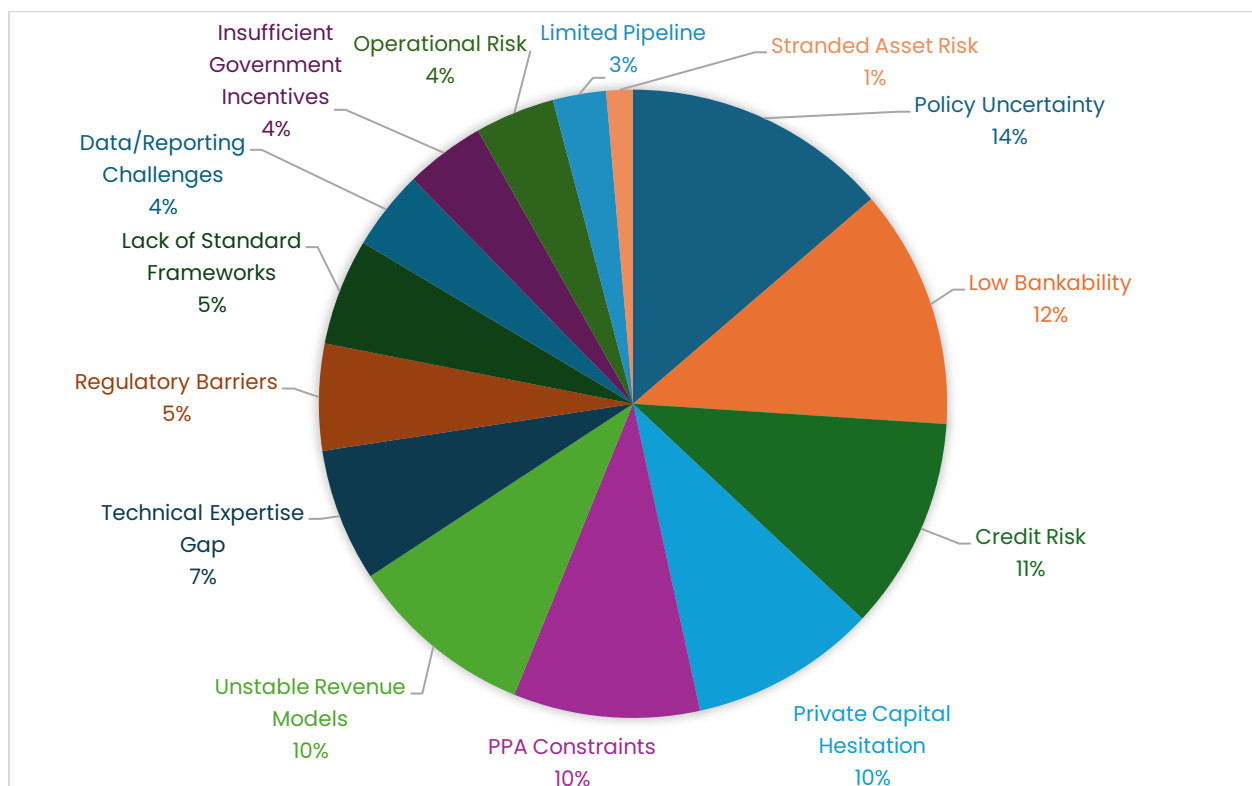
Additionally, by maintaining separate coding projects for financial institutions and for power plant owners, we preserved the ability to conduct stakeholder-specific analysis. This allowed us to generate figures and findings for each group independently. Any contrasts or commonalities between the two groups were then examined by juxtaposing the results. For example, if a particular barrier was frequently cited by plant owners but not by financiers (or vice versa), that divergence was noted as an essential insight. Conversely, themes that were common across both groups emerged as especially robust findings.

Key Findings: Constraints and Enablers in Early Coal Retirement

The coded interview data reveal a rich landscape of perceived barriers and proposed enablers for early coal plant retirement and the mobilization of transition finance. The figures provided these findings, with separate visuals for each stakeholder group and perspective, highlighting both challenges and solutions. In the discussion that follows, we interpret each figure in turn, highlighting the main insights and comparing trends across stakeholders and countries. Overall, a clear message emerges: both groups emphasize the critical role of government policy and support. However, they diverge on certain issues, reflecting their distinct roles in the transition finance ecosystem.

Financial Institutions: Proposed Challenges

Figure 1. Coded distribution of challenges cited by financial institutions



Source: Climate Finance Asia (2025)

Figure 1 illustrates the relative frequency of each barrier mentioned by interviewees from banks and other financial institutions, and Figure 2 illustrates the most prevalent challenges. Several dominant constraints stand out. Policy Uncertainty accounts for the largest share of coded segments (14% of all challenge mentions), making it the most cited challenge among financial actors. This underscores that an unstable or unclear policy environment, for instance, the absence of long-term coal phase-out plans or inconsistent renewable energy targets, is viewed as a top risk by financiers. Close behind are low bankability of projects (12%) and Credit Risk concerns (11%), which are highly prominent. These relate to the financial fundamentals of transition projects: many respondents perceive the current transition deals on offer as not financially attractive or creditworthy enough, in part due to uncertain revenues or unproven business models. Together, these top three issues compose a significant fraction of the concerns, indicating that the policy and financial viability context is the primary worry for investors considering coal transition financing.

Also significant are a cluster of other challenges, each making up roughly 10% of mentions: PPA Constraints, Private Capital Hesitation, and Unstable Revenue Models. These results are shown in Figure 2, each contributing just under or around 10 percent. The prevalence of inflexible long-term PPAs in many Asian markets, which lock in coal-generated power, is a key issue for financiers. They note that without renegotiating these contracts, early plant closures are very difficult, which in turn stalls financing for replacements. Private capital hesitation refers to the observed reluctance of many investors and lenders to engage in coal transition deals unless substantial risk mitigation is in place. Its high frequency underscores a chicken-and-egg problem: the very capital needed to finance transitions is waiting on external risk-reduction signals, often from governments. The concern about unstable revenue models is closely

related; financial institutions worry that even if they fund a transition project, the cash flows might not be reliable.

Figure 2. Top challenges cited by financial institutions



Source: Climate Finance Asia (2025)

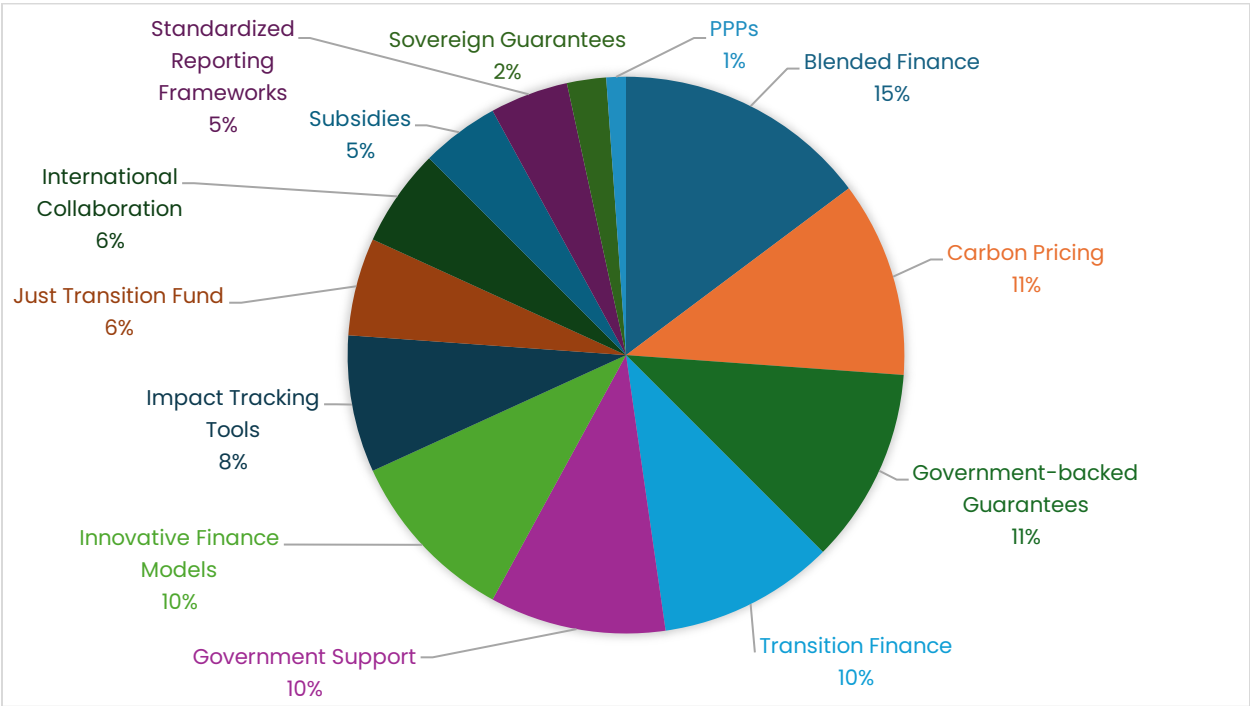
By contrast, some expected challenges were mentioned less frequently. For example, Regulatory Barriers (5%), Lack of Standard Frameworks (5%), and Data/Reporting Challenges (4%) were secondary concerns in terms of raw frequency. However, this does not mean they are unimportant. Several interviewees noted the lack of a standardized green taxonomy or the difficulty of ESG reporting; however, these concerns were overshadowed by the more immediate financial and policy risks, quantitatively. Insufficient Government Incentives (only 4%) was another somewhat surprising result. While many financiers noted the need for more government incentives in general, specific complaints about currently lacking incentives were less common than concerns about broader policy uncertainty or regulatory issues. Finally, a minimal share of references (only 1–3%) explicitly addressed Limited Pipeline or Stranded Asset Risk. This suggests that, within this group of interviewees, the

narrative was less about “there aren’t enough projects to invest in” and more about “the projects are there but not investable under current conditions”. This suggests that the risk of asset stranding, although a recognized concept, may be somewhat overshadowed by more immediate financing hurdles.

In summary, financial institutions across the case study countries consistently identified a risky operating environment as the primary barrier: unpredictable policy and market signals, combined with financially marginal projects, deter capital from flowing into the coal transition. Issues internal to financiers, such as capacity or data, were mentioned, but external structural factors dominated their concerns. Notably, these patterns were observed with remarkable consistency across interviews.

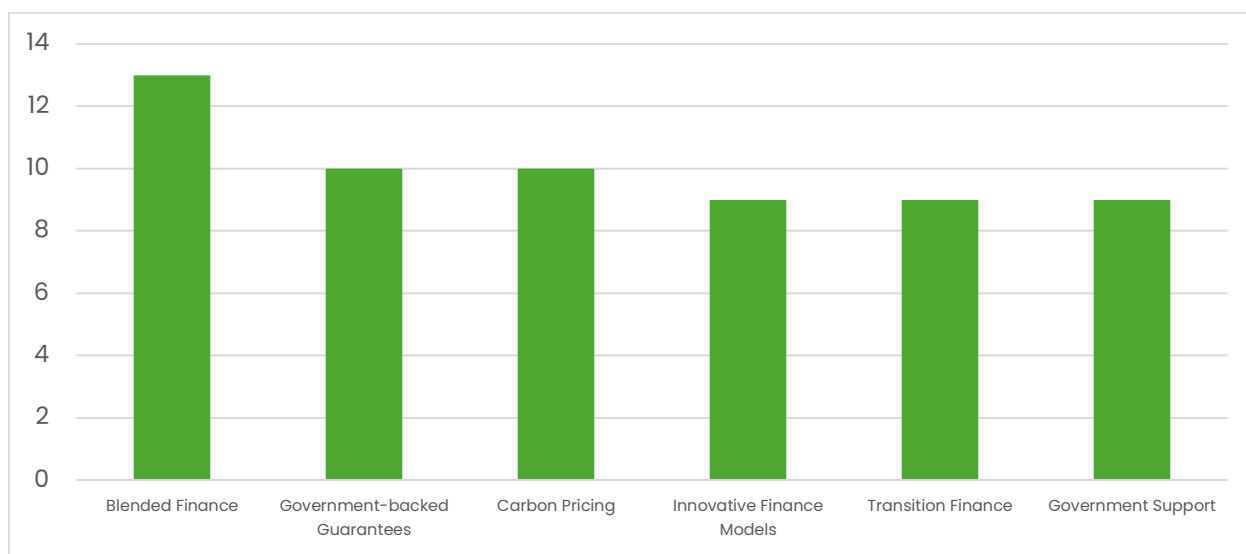
Financial Institutions: Proposed Solutions

Figure 3. Coded distribution of solutions cited by financial institutions



Source: Climate Finance Asia (2025)

Figure 4. Top solutions cited by financial institutions



Source: Climate Finance Asia (2025)

When asked about what could enable or accelerate coal transition financing, financial stakeholders offered a range of solutions, and the coding results show a somewhat more diffuse distribution of ideas (as seen in the diverse pie chart above). Even so, a clear priority emerges: Blended Finance mechanisms were the most frequently mentioned enabler, constituting about 15% of all solution-related references. This strong showing reflects a common sentiment that combining public and private capital – for example, using concessional funding from governments or MDBs to de-risk projects and attract commercial lenders – is critical to make challenging projects bankable. In essence, many interviewees view blended finance as the key to bridging the risk-reward gap that currently keeps purely private capital on the sidelines.

Several other solution categories each accounted for roughly 10–11% of mentions, indicating a set of nearly equally important measures. These include Government-backed Guarantees (around 11%), Carbon Pricing (11%), Transition Finance instruments (10%), Government Support in a broader sense (10%), and Innovative Finance Models (10%). The prominence of government guarantees and general government support underlines a recurring theme: financial institutions believe that government actions are indispensable for reducing

risks. Specifically, sovereign guarantees or other credit enhancements were frequently cited as a way to encourage banks to lend or invest in early retirement deals by effectively insuring them against downside risk. The appearance of carbon pricing as a top-tier solution is notable – it signals that many financiers see a well-designed carbon pricing mechanism as a game-changer that would improve the relative economics of clean energy vis-à-vis coal, thus naturally steering investment away from coal. In the interviews, some bank representatives pointed out that a robust carbon price (or equivalent regulation) would create demand for transition finance by penalizing coal operations and rewarding low-carbon projects, aligning private incentives with climate goals.

The emphasis on transition-specific financial instruments and innovative models (such as transition bonds or sustainability-linked loans) suggests that the financial community is also looking inward, pondering what new products or deal structures they can develop to facilitate this niche. Roughly one-tenth of the responses highlighted the need to tailor financial products to the unique challenges of coal transition – for example, loans that have step-down interest rates as emissions targets are met, or bonds earmarked for just transition purposes. This indicates an acknowledgement that traditional finance approaches alone may not suffice; innovation in finance is part of the solution set.

Beyond the top cluster, other enablers were mentioned somewhat less frequently but are still significant. Impact Tracking Tools (8% of mentions) and Standardized Reporting Frameworks (5%) together reflect a concern with measurement and transparency. Several institutions noted that having common frameworks (for disclosing climate risks, tracking emission reductions, etc.) and better tools to monitor project impacts would increase their confidence and ability to invest in transitions, by reducing information asymmetry and reputational risk. International Collaboration (6%) was another theme – this includes partnering with international climate funds or MDBs,

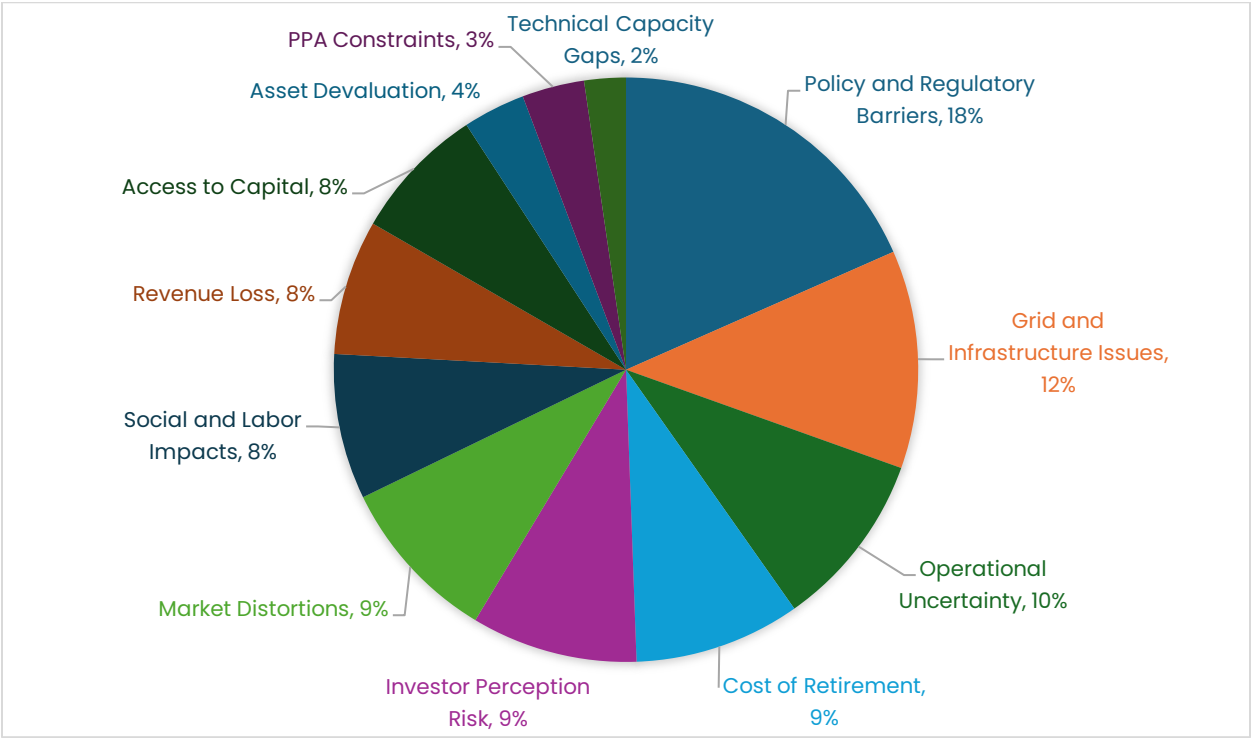
sharing knowledge, and co-financing deals across borders. The moderate frequency of this tag suggests that while international support is welcome (and often tied into ideas such as blended finance), local actors still focus slightly more on domestic actions such as national policy and guarantees.

Interestingly, Subsidies were only about 5% of solution mentions. While one might expect financiers to call for subsidies to improve project economics, it appears they framed their asks more in terms of risk mitigation (guarantees, concessional loans) rather than direct subsidies. This could be because subsidies are seen as something to benefit projects or plant owners directly, whereas guarantees and blended structures involve the financial institutions more directly. Finally, Just Transition Fund (6%) shows up as a niche but noteworthy idea – some respondents explicitly suggested creating funds earmarked to handle the social aspect of coal retirement (e.g. funding worker retraining and community development). Though not among the top four solutions, the fact that it appears at all indicates awareness among financial actors that the social dimension needs addressing (potentially because unresolved social issues can pose political and reputational risks to financiers).

Overall, the solutions proposed by financial institutions span policy, financial engineering, and market infrastructure. They paint a picture of a needed ecosystem: strong government policy signals and risk reduction, coupled with innovative financial instruments and support from international climate finance, all underpinned by better data and standards. Notably, these responses were broadly consistent across the different countries studied – for instance, bankers in countries facing imminent coal transitions echoed the same needs for guarantees and blended finance as those in countries where the transition is still more theoretical. This consistency suggests that, despite different national contexts, the finance community in Asia has a fairly unified view of what it would take to scale up investment in early coal retirement.

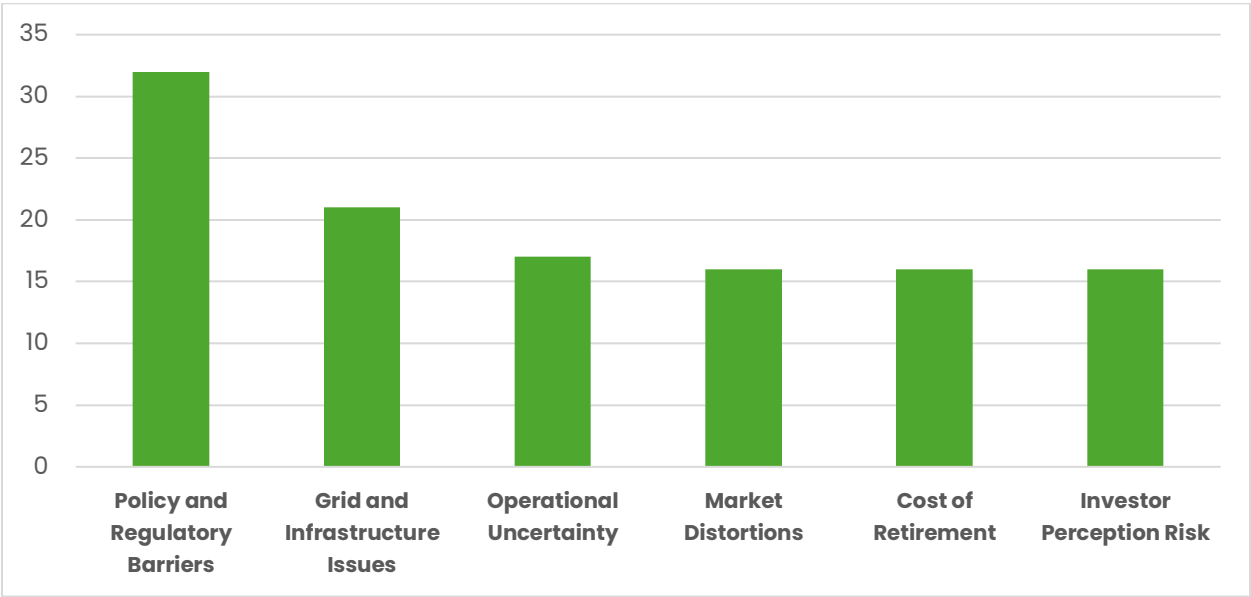
Power Plant Owners: Proposed Challenges

Figure 5. Coded distribution of challenges cited by coal power plant owners



Source: Climate Finance Asia (2025)

Figure 6. Top challenges cited by coal power plant owners



Source: Climate Finance Asia (2025)

The perspective of power plant owners highlights a somewhat different hierarchy of challenges, focusing more on the practical and financial pains of early retirement. As shown in figure 5, Policy and Regulatory Barriers dominate the concern set, accounting for approximately 18% of all challenge references; the single largest slice of the pie. This mirrors the financiers' focus on policy, but from the owners' angle, it often indicates a lack of compelling government direction or permission for early plant retirement. Many plant operators noted that, without official mandates, clear timelines, or regulatory approvals, they cannot proceed; in some cases, policies may even actively discourage retirement, such as when penalties are imposed for not meeting PPA supply obligations or when coal is subsidized. The fact that this category is the top concern underscores that owners across multiple countries feel constrained or unsupported by the current policy regime regarding the transition of their assets.

The second most cited challenge is Grid and Infrastructure Issues (roughly 12% of mentions). Plant owners are acutely aware that retiring a coal facility is not just a financial decision but also a technical one, the reliability of power supply must be maintained. In markets where the grid is not yet robust enough to handle variable renewables or where new transmission is needed, operators see a big obstacle: even if they wanted to retire a plant, the grid might not be ready to replace that capacity with renewables reliably. This concern was notably prevalent in interviews from countries facing rapid demand growth or those with weaker grid infrastructure. Following close behind, at about 10% of mentions, is Operational Uncertainty, which captures the uncertainties around the retirement process itself. Together, the prominence of policy barriers, grid limitations, and operational/process uncertainties paints a picture in which external dependencies are the major blockers from the plant owner's vantage point.

Financial and market concerns also play a significant role, but they are divided into several specific codes, each carrying roughly equal weight ($\approx 8-9\%$ each). Notably, Cost of Retirement ($\approx 9\%$), Investor Perception Risk ($\approx 9\%$), and Market Distortions ($\approx 9\%$) all rank near the top tier. The cost of retirement refers to the direct impact that owners face when closing a plant. This includes immediate cash outlays for decommissioning and the loss of future revenue. Interviewees frequently emphasized the need to cover these costs, indicating that without some form of compensation or recovery mechanism, they view early closure as financially unviable. Investor perception risk highlights that some plant owners are concerned about how the market will perceive the decision to retire assets early—will it be seen as a prudent pivot or a destruction of value? In countries where utilities depend on foreign investment or capital markets, this concern was even more pronounced. Market distortions, such as ongoing subsidies for coal power or regulated low electricity tariffs, were noted as challenges because they render coal financially viable while making renewables less competitive, thereby discouraging plant closures from a market perspective.

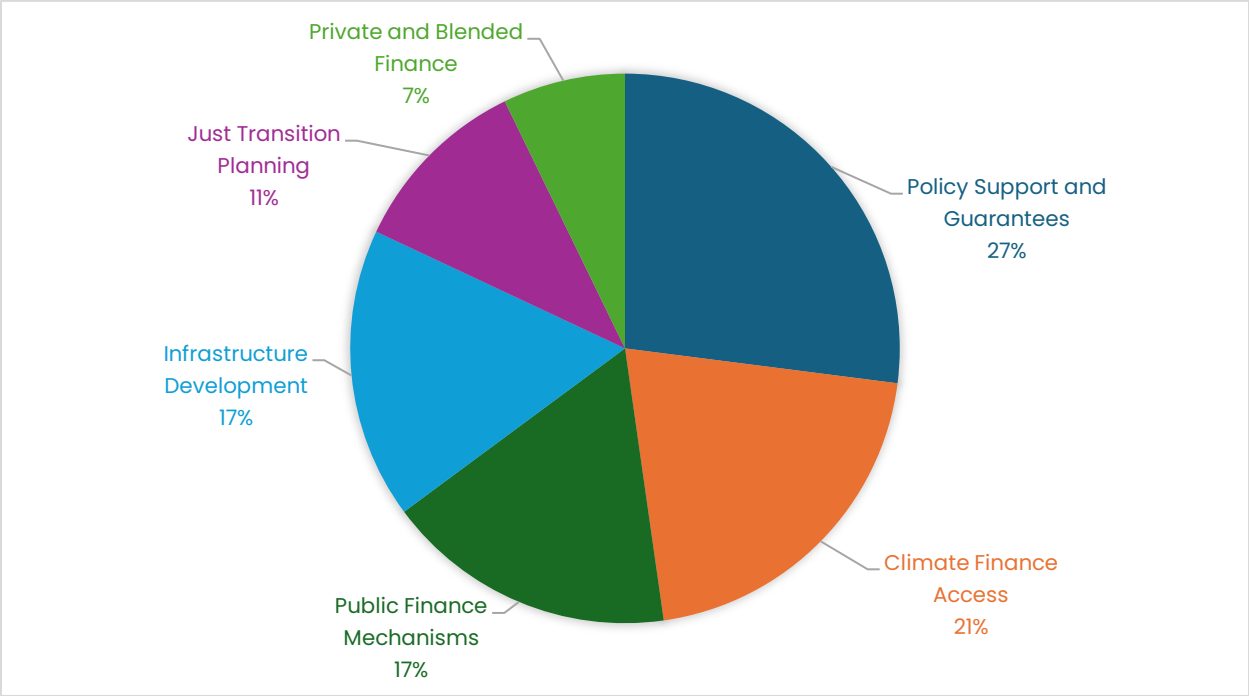
Other challenges for plant owners were acknowledged but occurred less frequently. Social and Labor Impacts and Revenue Loss each accounted for about 8% of the coded mentions. These are important factors; owners are clearly aware that shutting down a plant can lead to layoffs and community impacts, which may incite political backlash, and that it results in sacrificing a stream of income. However, while these issues were noted, they were not at the very top in overall frequency. This may be because some owners expect that the government or other stakeholders would handle social mitigation if a transition deal were struck. Access to Capital comprised another 8%; interestingly, although lack of financing is indeed a challenge, many plant owners seemed to focus first on the conditions that would make a retirement deal feasible, assuming that if those conditions are met, the financing aspect (raising capital) might follow. The relatively lower frequencies of Asset Devaluation (4%) and Technical Capacity Gaps (2%) suggest these were not

top priorities for most operators. Asset devaluation, the idea of writing off the plant's value, is inherently linked to revenue loss and compensation, so many might have included it in cost/revenue discussions rather than stating it separately. Additionally, while technical capacity is a real issue, it may have been seen as something that can be resolved if the decision to retire is made; it was rarely the first point raised as a blocker.

From a cross-country perspective, the dominance of policy and regulatory barriers was consistent, indicating a widespread sentiment that "if the government doesn't clearly enable or push for it, early retirement won't happen." The emphasis on grid issues was somewhat more pronounced in interviews from countries with less mature grids; however, even in relatively advanced systems, operators noted the need for grid upgrades to support transitions. Similarly, social issues were universally acknowledged but tended to be discussed in more detail in countries with a strong organized labor presence or where coal plants are major local employers.

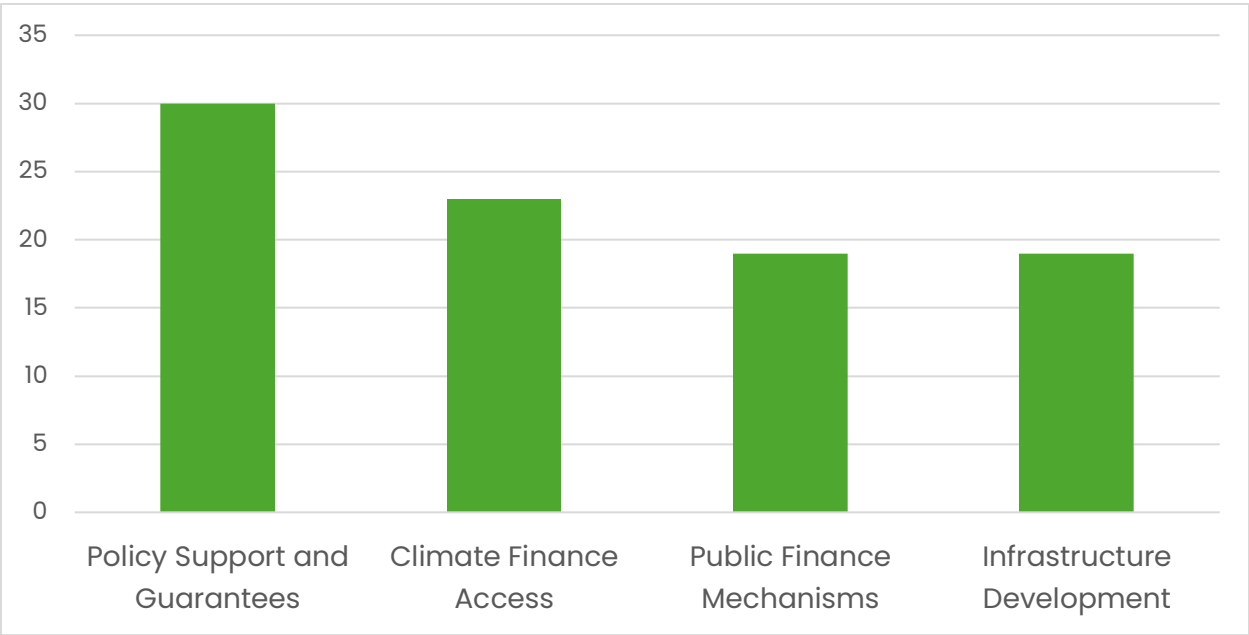
Power Plant Owners: Proposed Solutions

Figure 7. Coded distribution of solutions cited by coal power plant owners



Source: Climate Finance Asia (2025)

Figure 8. Top solutions cited by coal power plant owners



Source: Climate Finance Asia (2025)

In discussing what would facilitate coal plant retirements, plant owners overwhelmingly pointed to solutions involving government and financial support, aligning with the barriers they highlighted. Figures 8 and 9 summarize the distribution of solution themes for plant owners, and the top categories are evident. The most frequently cited enabler is Policy Support and Guarantees. Essentially, operators are saying: if the government wants us to transition, it must actively support and de-risk the process. This includes having clear policies and providing guarantees or assurances that, for example, if they shut down a plant, the company will not be left shouldering all the losses. The prominence of this code mirrors the top barrier; it is the direct antidote to policy uncertainty. Owners in multiple countries have called for measures such as sovereign guarantees on any remaining debt or revenue-support agreements to compensate for lost income, indicating that they seek a safety net from the public sector.

Close behind in frequency is Public Finance Mechanisms, which covers government or state-led funding to ease the financial burden of early retirement. Many plant owners suggested solutions, such as a dedicated transition fund or a compensation scheme that would pay plant owners an agreed-upon sum for closing early, or tax credits and subsidies for repurposing plant sites into renewable energy facilities. The high ranking of this solution underscores that, from the owner's perspective, money to cover the cost of closure is critical; they need to be made financially whole to be willing to retire assets. This was a common refrain: without some form of buy-out, cash compensation, or liability taken care of by the government, early retirement would be economically irrational for them to undertake.

The third major category is Private and Blended Finance. Plant operators acknowledged that public resources alone may not be sufficient; hence, attracting private investment, especially for building replacement capacity such as solar or gas, or for funding clean-up and redevelopment of retired plant sites, is necessary. However, these interviews also made it clear that such

private finance is only realistic if blended structures are in place. In other words, owners recognize that investors will come in if risks are mitigated through public co-financing or guarantees, which ties back to the first two solution categories. Some operators expressed interest in public-private partnership models for replacement power projects, where the government might take on a portion of the project or provide incentives to the private partner. The appearance of this code as a top solution signals that plant owners are open to working with new investors and capital, but they see the government as playing a catalyst role in making those partnerships attractive.

Beyond these top three, other solutions were mentioned with somewhat lower frequency. Climate Finance Access was one; several plant owners expressed hope or interest in tapping into international climate funds or multilateral development bank programs to support their transitions. This included not only obtaining affordable loans but also receiving technical assistance from organizations with global experience in decommissioning and transition. While not cited as frequently as domestic policy measures, this reflects an awareness in the industry that global climate finance exists and could be leveraged, particularly in countries where national budgets are constrained. Infrastructure Development is another notable solution area. This directly addresses the grid and infrastructure barrier; several interviewees argued that strengthening the grid would enable more plant retirements, as reliability concerns would be diminished. Although not the leading solution in terms of count, it's clearly significant, especially for operators who currently must keep coal units running as a measure of grid stability.

Finally, Just Transition Planning was mentioned by some plant owners, though relatively few in number. Those who discussed it emphasized the need for concrete plans to address worker layoffs, retraining, and community impacts, often suggesting that government-led programs could help reduce local opposition to plant closures. The lower frequency of this code may indicate that while owners are aware of the labor issue, they see it as a secondary concern

that follows major financial decisions or they assume it is primarily the government's responsibility to manage. Additionally, it may reflect that some interviewees, focusing on financial and technical matters, did not explore social solutions in depth during the conversation. Nevertheless, its presence as a coded theme demonstrates that the concept of a "just transition" has entered the discourse: some power companies recognize that retiring coal early will require attention to the human side of the equation, not just the balance sheets.

In interviews with plant owners across different countries, the wishlist of solutions was notably aligned. In every case, interviewees emphasized forms of government support, including policy guarantees, funding, or both, as the cornerstone for enabling transitions. This indicates a broad regional pattern: coal asset owners are unlikely to pursue early retirement without decisive public-sector intervention and incentives. The nuances by country emerged in the specific mechanisms emphasized; for example, in countries with existing energy transition funds or government compensation programs, owners referenced those and stated they should be expanded or better implemented. Regardless of location, the fundamental enablers mentioned remain consistent, reinforcing the idea that the barrier-enabler pairing (e.g., policy problem vs. policy solution, financial gap vs. financial support) is common to all.

Cross-Cutting Insights and Comparative Trends

Bringing together the perspectives of financial institutions and power plant owners reveals both common ground and clear divergences in how these stakeholders view the challenge of transitioning from coal. A key insight that crosses boundaries is the critical importance of government action. Both groups, in their own way, indicate that without stronger and more credible government intervention, whether through policy clarity, guarantees, or financial incentives, the pathway to early coal retirements will remain challenging. This alignment is evident in how "policy and regulatory" factors

are perceived: financial institutions fear policy uncertainty and call for government guarantees and support, while plant owners feel constrained by policy gaps and call for government compensation and clear mandates. In essence, policy stability and government backing emerge as the linchpin of any solution set, bringing stakeholder views together.

Another common theme is the need for risk mitigation to unlock capital. Both financiers and plant owners discuss risk, though they focus on different aspects. Financiers are concerned with credit risk, revenue volatility, and the absence of bankable projects, while plant owners are focused on financial losses and investor perceptions. Ultimately, both parties point to risk-sharing mechanisms, such as guarantees, blended finance, or public funds, as potential solutions. This indicates that an effective model for early coal retirement must equitably distribute risks and costs between the public and private sectors; if either side perceives that they are shouldering excessive risk, they will hesitate. The alignment of instruments such as guarantees and blended finance in both codebooks strongly illustrates this point.

Despite these overlaps, the analysis also highlights diverging viewpoints and priorities. One noticeable difference is in the complexity of the financial mechanisms discussed. Financial institutions, being in the business of finance, naturally brought up more technical financial concepts (carbon pricing, new bond structures, reporting standards, etc.) as part of their solution set. They are looking at market-based mechanisms and innovations that would make investing in transitions more attractive. In contrast, plant owners focused on more direct, tangible supports; essentially, “write us a check or give us a guarantee so we can afford to do this.” For instance, carbon pricing featured in the financiers’ top solutions, but it was virtually absent from plant owners’ responses; many plant operators did not spontaneously propose a carbon tax or carbon market as a solution for their predicament. Similarly, standardized reporting and ESG data improvements were a notable theme for financiers, but not for plant owners, reflecting that issues of transparency or taxonomy, while

necessary for mobilizing investment, are not the immediate concern of someone running a power plant.

Another divergence is in the emphasis on social issues. Plant owners did mention labor and community impact concerns, whereas financial institution interviewees, for the most part, did not raise social issues at all as a barrier or a solution. This is understandable: the social impact of plant closure is a direct operational concern for plant owners, whereas banks are a step removed from this. However, for policymakers, this gap is noteworthy. It suggests that if social considerations are not proactively addressed, plant owners may be hesitant to proceed, even if financiers are ready with capital. Bridging this gap may require policy interventions that specifically target just transition outcomes, so that both stakeholders' needs are met.

In summary, the empirical evidence from the interviews provides a clear view of the barriers and enabling factors for accelerating coal transition finance. There is widespread agreement that current conditions, from policy frameworks to project economics, are inadequate to attract the level of capital needed for early coal retirements. Stakeholders on both the supply and demand sides identify a variety of solutions, most of which entail active roles for government policy, international finance, and innovative financial structuring. By understanding the obstacles on the ground and the support mechanisms required by practitioners, we can better determine what policy and market interventions will be necessary. The next chapter will build on these insights to develop policy implications and recommendations, bridging the gap between identified challenges and the practical steps needed to achieve a just and financeable coal transition.

Policy Recommendations Based on the Empirical Analysis

Based on the findings above, a set of targeted policy recommendations is proposed to address the key barriers and leverage the identified enablers.

These recommendations focus on economic and financial pathways to accelerate coal phase-outs, directly reflecting the challenges and solutions highlighted by financial institutions and power plant operators.

Strengthen Policy Clarity and Provide Sovereign Guarantees to De-risk Investments

Governments should create clear and credible coal transition roadmaps. For instance, official coal phase-out schedules or early retirement incentive programs, and support these policies with robust risk mitigation measures. Clear mandates and timelines from authorities will help reduce the policy uncertainty currently seen as the top concern for financiers. Equally important is offering sovereign guarantees or other public credit enhancements to address key risks in coal retirement deals. The empirical findings showed that both stakeholder groups emphasized this need: financial institutions highlighted that government guarantees and support are essential for reducing investment risk, and plant owners stressed that if the government wants them to transition, it must actively support and “de-risk” the process. In short, policy stability and government backing emerged as the linchpin of any solution set without more credible intervention from the state, early coal retirements will remain extremely challenging.

In practice, this recommendation means that governments should not only announce coal reduction targets but also implement concrete measures to reassure investors. Sovereign-backed guarantees can ensure that lenders will be fully compensated even if a transition project does not perform as expected, thereby addressing the credit risk and low bankability issues identified in the interviews. Several plant operators in the study called for exactly this kind of safety net. For instance, guarantees to cover remaining loan obligations or revenue shortfalls in the event that a plant is closed ahead of schedule. Likewise, many banks indicated they would be much more willing to finance early retirements if sovereign guarantees or similar risk-sharing tools were

established. Regulators should also tackle contractual barriers by allowing the renegotiation of rigid PPAs that currently lock in coal generation. Creating legal avenues to amend or buy out long-term PPAs without incurring punitive penalties is essential, as inflexible PPAs have been identified as a significant obstacle by both financiers and operators. By providing clear policy signals and assuming some of the transition risk, the public sector can significantly enhance the investment case for early retirement of coal plants.

Establish Transition Finance Facilities and Compensation Mechanisms

Policymakers should establish dedicated transition finance facilities, such as national “coal transition” funds or other public financing mechanisms, to cover the upfront costs of early coal plant retirement. These funds would provide the financial incentives necessary to make plant owners economically secure when agreeing to retire the facility before its full lifespan. Qualitative evidence strongly underscores this need: many plant operators suggested creating a dedicated transition fund or compensation scheme to pay owners an agreed sum for closing early. From the owners’ perspective, having the government or a public fund cover decommissioning expenses, remaining debt, or forgone revenues is critical. Without some form of buyout or cash compensation, early retirement would be economically irrational for them to undertake. A transition finance facility can also provide targeted subsidies or tax credits, allowing new clean infrastructure to be developed without imposing prohibitive costs on the companies involved.

Establishing such a fund may involve earmarking public budget resources and mobilizing international climate finance to pool the necessary capital. Interviewees from various countries consistently highlighted public funding as the cornerstone of any viable transition deal. In jurisdictions that already have energy transition funds or compensation programs, plant owners in the study urged that these initiatives be expanded and properly implemented. Where these do not exist, respondents referenced international models (such as

Indonesia's Energy Transition Mechanism or the Just Energy Transition Partnership) as examples to emulate. Therefore, governments should collaborate with development partners, including multilateral climate funds and development banks, to capitalize these facilities. By providing a precise mechanism to buy out coal assets and finance the transition, such funds would directly address asset devaluation and cost-of-retirement barriers, giving plant owners a viable financial pathway to exit coal while investing in cleaner alternatives.

Mobilize Private Capital through Blended Finance and Innovative Instruments

Given the scale of investment required to replace coal, the public sector should actively catalyze private capital participation by utilizing blended finance models and innovative financial instruments. Blended finance, the strategic use of concessional public funds alongside market-rate private finance, was the single most frequently cited enabler by financial institutions in our study. This approach helps bridge the risk-reward gap that currently keeps purely private investors on the sidelines by allowing governments or development banks to absorb part of the risk (for instance, through junior equity tranches, first-loss capital, or grant support), thus improving the bankability of projects. Power plant operators similarly acknowledged that private investment is necessary but only feasible if risk is mitigated through public co-financing or guarantees. To operationalize this, governments should structure public-private partnership (PPP) models and co-financing arrangements for transition projects—for example, partnering with multilateral development banks (MDBs) or national development finance institutions to offer credit enhancements and low-interest loans that attract commercial lenders. Successful international examples could serve as valuable lessons: interviewees pointed to initiatives such as Indonesia's blended-finance Energy Transition Mechanism as a template for how concessional funds can be combined with private money to retire coal assets. By sharing risks and returns

in innovative ways, such public-private platforms can unlock significantly more capital than public budgets alone, addressing the substantial financing needs of a coal-to-clean transition.

Additionally, stakeholders highlighted the importance of creating innovative financial products tailored to transition goals. Many financiers are exploring new instruments, such as transition bonds, sustainability-linked loans, green sukuk (Islamic green bonds), and debt-for-climate swaps, to engage investors in novel ways. These tools can be structured to incentivize and reward successful outcomes in coal phase-out. For instance, a utility could issue a sustainability-linked bond that offers lower interest rates once specific coal capacity is retired, aligning financial returns with climate performance. Similarly, sovereign or corporate green sukuk issuances can tap into Islamic finance markets to fund renewable energy and transition projects. Governments and regulators should collaborate with the financial sector to establish guidelines and frameworks for such instruments, ensuring they meet transparency and credibility standards. By embracing financial innovation and partnering with international climate finance initiatives, policymakers can significantly expand the pool of funding available for coal transition, while also signalling to markets that this new class of investments is both viable and welcome.

Invest in Grid Modernization and Reliability Measures

A robust and flexible power grid is essential for retiring coal plants without threatening energy security. Governments should prioritize investments in grid modernization, expansion, and reliability measures to facilitate greater integration of renewable energy. The interviews revealed that inadequate grid infrastructure is a significant practical barrier: power plant owners frequently cited insufficient transmission capacity and grid constraints as a significant obstacle. Many operators argued that even if financing and policy support were available, they cannot retire certain coal facilities until the grid can

reliably manage replacement power. In turn, several interviewees suggested that targeted grid upgrades, such as constructing new transmission lines to renewable-rich regions, enhancing grid flexibility and storage, and improving system stability tools, would open the door for more coal plant retirements by alleviating reliability concerns.

Policymakers should therefore integrate grid development plans with the coal transition strategy. This could include directing public infrastructure spending and development bank financing toward transmission and distribution improvements, smart grid technologies, and regional interconnections that help balance variable renewable energy supply. By strengthening their electricity networks, countries cannot only facilitate the integration of wind and solar generation to replace coal but also reduce the risk that a retired coal plant could leave a local supply gap. Plant operators in multiple countries have deemed it necessary to address these infrastructure needs proactively, underscoring the need to solve both technical and financial constraints. In summary, grid modernization efforts will provide the backbone that enables other transition finance initiatives to succeed, ensuring that clean energy can reliably replace retiring coal capacity.

Reform Market Incentives: Phase Out Fossil Subsidies and Introduce Carbon Pricing

Policymakers should realign market incentives to favor clean energy investments and discourage continued coal use. This begins with phasing out fossil-fuel subsidies and other market distortions that artificially prop up coal power. In many developing Asian countries, government support, such as subsidized coal prices, capacity payments, or regulated electricity tariffs, has kept coal plants economically comfortable, thereby disincentivizing early retirement. Removing or redirecting these subsidies and ensuring electricity pricing reflects true costs would make low-carbon alternatives more competitive by comparison. In parallel, authorities need to implement credible

carbon pricing mechanisms over the medium term, whether through a carbon tax or an emissions trading system. Financial institutions interviewed in this study frequently highlighted carbon pricing as a potential game-changer that could improve the relative economics of clean energy compared to coal. A robust carbon price signal would penalize heavy carbon emitters and reward investments in renewables, naturally steering capital away from coal. While most plant owners did not advocate for carbon taxes themselves, understandably, since it would raise their costs, establishing a modest carbon price or shadow price can gradually shift expectations and investment planning in favor of cleaner options.

Regulatory reforms should accompany these economic incentives. Governments can create transition-friendly market conditions by updating power market rules – for example, removing contractual penalties or quota obligations that force utilities to continue operating coal plants when cheaper or cleaner generation is available. Equally important is enabling the renegotiation of long-term power purchase agreements (PPAs), which currently lock in coal generation. These PPAs often contain take-or-pay clauses or sovereign guarantees that hinder early retirement. Regulatory adjustments should clarify pathways for voluntary renegotiation or repurchase of such contracts, allowing parties to exit coal commitments without triggering legal or financial penalties. Introducing competitive bidding for replacement renewable capacity and ensuring fair access to the grid for new entrants will further strengthen the economic case for retiring coal. Over time, these market reforms will work with direct financial support to accelerate the transition. As coal becomes less financially attractive and carbon costs are internalized, the flow of capital toward sustainable energy projects is expected to increase. The combination of subsidy removal, carbon pricing, and modernized market rules sends a powerful signal that the era of cheap, unchecked coal power is ending, prompting investors and plant operators to pivot more decisively toward clean energy.

Build Technical Capacity and Project Preparation Support

The success of transition finance also hinges on strengthening the technical capacity of local stakeholders and developing a pipeline of bankable projects. Governments and international partners should invest in capacity-building programs for both financial institutions and power utilities to address the knowledge gaps identified in the study. Many local banks are still developing the expertise to evaluate and structure complex coal-to-clean energy deals, and many power plant operators lack the technical experience in planning renewable energy projects or repurposing strategies for their plants. Targeted training and knowledge transfer can help bridge these gaps. For instance, workshops or advisory services on topics such as project finance structuring, risk assessment for transition projects, and engineering planning for plant decommissioning and renewable integration. By building human capital in these areas, countries will be better equipped to design viable transition projects that can attract investment.

In parallel, policymakers should support early-stage project preparation to expand the pipeline of investable opportunities. The interviews suggested that stakeholders see projects as available but often not “bankable” under current conditions, indicating a need for stronger upfront project development. To address this, governments can establish dedicated technical assistance facilities to help identify, design, and vet coal transition projects. Such facilities could assist plant owners in conducting feasibility studies, environmental and social impact assessments, and business model restructuring for repurposing sites (e.g., converting a coal plant site to a solar farm or battery storage facility). They can also develop standardized tools and templates for transition financing proposals, reducing transaction costs for lenders otherwise deterred by these deals’ novelty. By proactively nurturing projects from concept to bankability, policymakers can reduce the concern about a lack of bankable projects and ensure a steady pipeline of credible transition investments ready for financing.

Develop Transition Finance Taxonomies and Reporting Standards

Finally, regulators should develop clear taxonomies and reporting standards specific to coal transition projects to foster transparency and credibility in transition finance. One barrier identified in the interviews was the lack of common definitions or criteria for what qualifies as a “transition” investment, which makes it challenging for banks to determine which projects are eligible. To address this issue, governments and financial regulators can create or adopt a transition finance taxonomy, essentially a classification system, that outlines the types of projects and expenditures considered aligned with the phase-out of coal. A well-defined taxonomy, ideally harmonized with international best practices, will give financial institutions greater confidence that their investments meet accepted standards and are not merely “greenwashed.”

In tandem, standardized reporting and disclosure requirements should be established for transition finance transactions. Common frameworks for measuring and reporting these projects' climate and social impacts will reduce information asymmetries and enhance investor trust. Indeed, several financial institutions noted that harmonized ESG disclosure standards and better impact tracking tools would improve their ability to invest in transitions by providing reliable data and accountability. Policymakers can mandate that plant owners and utilities publish transition plans and progress reports, following climate disclosure guidelines. Although issues such as taxonomy and reporting were not the most frequently raised concerns in absolute terms, they are an important part of the enabling environment. By improving clarity and transparency, these measures complement the financial and policy interventions mentioned above, helping ensure that capital is directed to truly impactful projects and that all stakeholders can monitor the outcomes of coal transition efforts. Over time, a strong disclosure regime and clear criteria will also facilitate access to international funding, as global investors increasingly require robust standards when backing transition finance initiatives.

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Appendices

Appendix 1: Commercial Bank's Perspective on Financing the Coal Phaseout (1)

Appendix 2: Commercial Bank's Perspective on Financing the Coal Phaseout (2)

Appendix 3: Commercial Bank's Perspective on Financing the Coal Phaseout (3)

Appendix 4: Commercial Bank's Perspective on Financing the Coal Phaseout (4)

Appendix 5: Policy Bank's Perspective on Financing the Coal Phaseout (1)

Appendix 6: Policy Bank's Perspective on Financing the Coal Phaseout (2)

Appendix 7: MDB's Perspective on Financing the Coal Phaseout (1)

Appendix 8: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Bangladesh – Rampal Coal Power Plant

Appendix 9: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Bangladesh – Barapukuria Coal Mine

Appendix 10: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Indonesia – PT. PLN Indonesia Power

Appendix 11: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Malaysia – TNB GENCO

Appendix 12: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Malaysia –Solar Energy Research Institute, Universiti Kebangsaan Malaysia

Appendix 13: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Malaysia –Institute of Strategic and International Studies (ISIS) Malaysia

Appendix 14: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Pakistan – Port Qasim Power Plant (Karachi)

Appendix 15: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Pakistan – Sahiwal Coal Power Plant (Punjab)

Appendix 1: Questionnaire: Commercial Bank's Perspective on Financing the Coal Phaseout (1)

1. Institutional Policy on Coal Financing

1. Has your bank set a policy to phase out coal financing?
 - A. **Yes, we have a formal commitment with a clear timeline.**
 - B. We are considering it but have not set a timeline.
 - C. We have no immediate plans to phase out coal financing.
 - D. We continue to finance coal projects with no restrictions.
2. What is the primary factor influencing your bank's approach to coal financing?
 - A. Regulatory requirements and government policies
 - B. Market and investor pressure
 - C. Financial profitability of coal projects
 - D. **Corporate sustainability commitments**
3. How does your institution currently approach financing for the coal transition?
 - A. **Actively financing coal transition projects**
 - B. Exploring financing opportunities but not actively investing
 - C. Only considering projects with strong government backing.
 - D. Not currently involved in coal transition financing

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing coal phaseout?
 - A. **High cost and low profitability of coal phaseout**
 - B. Limited bankable renewable energy projects
 - C. Uncertainty in policy and regulations
 - D. High transaction costs
5. What is the most challenging aspect of assessing transition finance risks?
 - A. **Unclear financial returns from coal transition projects**
 - B. Limited successful case studies on coal-to-renewables transition
 - C. Difficulty in monitoring compliance with sustainability criteria
 - D. Lack of standardized risk assessment frameworks
6. How concerned is your bank about potential defaults by coal plant operators undergoing transition?
 - A. Highly concerned; significant credit risk
 - B. Moderately concerned; risk varies by market
 - C. **Slightly concerned; risk is manageable**
 - D. Not concerned; strong risk mitigation measures in place

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your bank find most suitable for coal phase-out projects?
 - A. Blended finance models
 - B. Transition bonds
 - C. **Sustainability-linked loans**
 - D. Green investment funds
8. Would your bank consider participating in a Just Transition Fund to support the phaseout of coal?
 - A. **Yes, actively seeking opportunities**
 - B. Possibly, if financial risks are mitigated
 - C. Not at this time, but open to future involvement
 - D. No, not interested

9. What role does private capital play in your bank's coal transition strategy?
- A. Major role: we actively seek private-sector co-financing
 - B. Important, but requires de-risking measures**
 - C. Limited: we primarily rely on public-sector guarantees
 - D. Minimal: We prioritize government-backed projects

4. Government Policies & Incentives

10. What policy measure would most encourage your bank to finance the coal phaseout?
- A. Government-backed guarantees and risk-sharing mechanisms
 - B. Carbon pricing and other regulatory drivers**
 - C. Direct financial incentives for renewable energy investments
 - D. A combination of regulatory mandates and economic benefits
11. How do government policies in your bank's key operating markets influence your coal transition financing?
- A. Strongly support coal phaseout financing
 - B. Provide some incentives but not sufficient**
 - C. Neutral; no clear direction
 - D. Favor coal investments over transition projects

12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?
- A. Crucial: We require stable revenue guarantees**
 - B. Important but not the only factor
 - C. Somewhat important, but risk-sharing mechanisms matter more
 - D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?
- A. Highly attractive
 - B. Moderately attractive
 - C. Neutral**
 - D. Unattractive
14. Which Asian country presents the best investment opportunities for coal phaseout financing?
- A. Indonesia**
 - B. Malaysia
 - C. The Philippines
 - D. Pakistan
15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?
- A. More attractive than traditional infrastructure projects
 - B. About the same as other infrastructure investments
 - C. Less attractive but manageable with risk mitigation**
 - D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your bank to collaborate with international climate finance initiatives?
- A. Very willing; actively seeking partnerships**
 - B. Somewhat willing; open to discussions
 - C. Neutral; case-by-case basis
 - D. Not interested
17. What kind of support would help your institution increase coal transition financing?
- A. Stronger policy incentives from governments
 - B. Better risk mitigation tools from financial institutions

- C. More standardized sustainability reporting frameworks
- D. **Increased availability of blended finance options**

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phase-out?
- A. Lack of technical expertise in transition finance
 - B. **Difficulties in structuring financial agreements**
 - C. Unclear regulatory requirements
 - D. Limited engagement with power plant operators
19. How does your bank track and assess the impact of coal transition projects?
- A. **Using internal ESG performance indicators**
 - B. Following external sustainability reporting standards
 - C. Relying on third-party assessments
 - D. We do not have a formal tracking system

8. Future Trends in Energy Transition Finance

20. Over the next 5 years, how do you see your institution's role in coal phaseout financing?
- A. Significantly increasing involvement
 - B. **Gradually increasing participation**
 - C. Maintaining current levels
 - D. Decreasing or exiting coal transition financing
21. How do you anticipate global energy market trends will impact your coal transition financing strategy?
- A. **Accelerating transition efforts**
 - B. Moderately influencing our strategy
 - C. Uncertain impact
 - D. Minimal influence
22. What emerging financing tool do you consider the most promising for the coal transition?
- A. **Carbon credits**
 - B. Transition loans
 - C. Green securitization
 - D. Debt-for-climate swaps
23. What is your bank's long-term stance on investments in fossil fuels?
- A. Phasing out all fossil fuel financing
 - B. Focusing on cleaner fossil fuel alternatives (e.g., natural gas)
 - C. **Continuing fossil fuel investments with sustainability conditions**
 - D. No change in the current investment strategy
24. Would your bank be interested in piloting innovative models for coal transition finance?
- A. **Yes, we are actively looking for opportunities**
 - B. Possibly, if risk-adjusted returns are favorable
 - C. Not at this time, but open to future discussions
 - D. No, we prefer traditional financing models.

Appendix 2: Questionnaire: Commercial Bank's Perspective on Financing the Coal Phaseout (2)

1. Institutional Policy on Coal Financing

1. Has your bank set a policy to phase out coal financing?
- A. **Yes, we have a formal commitment with a clear timeline.**

- B. We are considering it but have not set a timeline.
- C. We have no immediate plans to phase out coal financing.
- D. We continue to finance coal projects with no restrictions.

2. What is the primary factor influencing your bank's approach to coal financing?

- A. **Regulatory requirements and government policies**
- B. Market and investor pressure
- C. Financial profitability of coal projects
- D. Corporate sustainability commitments

3. How does your institution currently approach financing for the coal transition?

- A. **Actively financing coal transition projects**
- B. Exploring financing opportunities but not actively investing
- C. Only considering projects with strong government backing.
- D. Not currently involved in coal transition financing

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing coal phaseout?

- A. **High cost and low profitability of coal phaseout**
- B. Limited bankable renewable energy projects
- C. Uncertainty in policy and regulations
- D. High transaction costs

5. What is the most challenging aspect of assessing transition finance risks?

- A. **Unclear financial returns from coal transition projects**
- B. Limited successful case studies on coal-to-renewables transition
- C. Difficulty in monitoring compliance with sustainability criteria
- D. Lack of standardized risk assessment frameworks

6. How concerned is your bank about potential defaults by coal plant operators undergoing transition?

- A. Highly concerned; significant credit risk
- B. Moderately concerned; risk varies by market
- C. **Slightly concerned; risk is manageable**
- D. Not concerned; strong risk mitigation measures in place

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your bank find most suitable for coal phase-out projects?

- A. **Blended finance models**
- B. **Transition bonds**
- C. Sustainability-linked loans
- D. Green investment funds

8. Would your bank consider participating in a Just Transition Fund to support the phaseout of coal?

- A. Yes, actively seeking opportunities
- B. **Possibly, if financial risks are mitigated**
- C. Not at this time, but open to future involvement
- D. No, not interested

9. What role does private capital play in your bank's coal transition strategy?

- A. Major role: we actively seek private-sector co-financing
- B. **Important, but requires de-risking measures**
- C. Limited: we primarily rely on public-sector guarantees
- D. Minimal: We prioritize government-backed projects

4. Government Policies & Incentives

10. What policy measure would most encourage your bank to finance the coal phaseout?
- A. **Government-backed guarantees and risk-sharing mechanisms**
 - B. **Carbon pricing and other regulatory drivers**
 - C. **Direct financial incentives for renewable energy investments**
 - D. **A combination of regulatory mandates and economic benefits**
11. How do government policies in your bank's key operating markets influence your coal transition financing?
- A. Strongly support coal phaseout financing
 - B. **Provide some incentives but not sufficient**
 - C. Neutral; no clear direction
 - D. Favor coal investments over transition projects
12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?
- A. **Crucial: We require stable revenue guarantees**
 - B. Important but not the only factor
 - C. Somewhat important, but risk-sharing mechanisms matter more
 - D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?
- A. Highly attractive
 - B. **Moderately attractive**
 - C. Neutral
 - D. Unattractive
14. Which Asian country presents the best investment opportunities for coal phaseout financing?
- A. Indonesia
 - B. Malaysia
 - C. The Philippines
 - D. Pakistan
15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?
- A. **More attractive than traditional infrastructure projects**
 - B. About the same as other infrastructure investments
 - C. Less attractive but manageable with risk mitigation
 - D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your bank to collaborate with international climate finance initiatives?
- A. **Very willing; actively seeking partnerships**
 - B. Somewhat willing; open to discussions
 - C. Neutral; case-by-case basis
 - D. Not interested
17. What kind of support would help your institution increase coal transition financing?
- A. **Stronger policy incentives from governments**
 - B. **Better risk mitigation tools from financial institutions**
 - C. **More standardized sustainability reporting frameworks**
 - D. **Increased availability of blended finance options**

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phase-out?
- A. **Lack of technical expertise in transition finance**

- B. Difficulties in structuring financial agreements**
- C. Unclear regulatory requirements
- D. Limited engagement with power plant operators**

19. How does your bank track and assess the impact of coal transition projects?

- A. Using internal ESG performance indicators**
- B. Following external sustainability reporting standards**
- C. Relying on third-party assessments
- D. We do not have a formal tracking system

8. Future Trends in Energy Transition Finance

20. Over the next 5 years, how do you see your institution's role in coal phaseout financing?

- A. Significantly increasing involvement
- B. Gradually increasing participation**
- C. Maintaining current levels
- D. Decreasing or exiting coal transition financing

21. How do you anticipate global energy market trends will impact your coal transition financing strategy?

- A. Accelerating transition efforts**
- B. Moderately influencing our strategy
- C. Uncertain impact
- D. Minimal influence

22. What emerging financing tool do you consider the most promising for the coal transition?

- A. Carbon credits**
- B. Transition loans
- C. Green securitization
- D. Debt-for-climate swaps

23. What is your bank's long-term stance on investments in fossil fuels?

- A. Phasing out all fossil fuel financing
- B. Focusing on cleaner fossil fuel alternatives (e.g., natural gas)
- C. Continuing fossil fuel investments with sustainability conditions
- D. No change in the current investment strategy**

24. Would your bank be interested in piloting innovative models for coal transition finance?

- A. Yes, we are actively looking for opportunities
- B. Possibly, if risk-adjusted returns are favorable**
- C. Not at this time, but open to future discussions
- D. No, we prefer traditional financing models.

Appendix 3: Questionnaire: Commercial Bank's Perspective on Financing the Coal Phaseout (3)

1. Institutional Policy on Coal Financing

1. Has your bank set a policy to phase out coal financing?

- A. Yes, we have a formal commitment with a clear timeline.**
- B. We are considering it but have not set a timeline.
- C. We have no immediate plans to phase out coal financing.
- D. We continue to finance coal projects with no restrictions.

2. What is the primary factor influencing your bank's approach to coal financing?

- A. Regulatory requirements and government policies**
- B. Market and investor pressure
- C. Financial profitability of coal projects

D. Corporate sustainability commitments

3. How does your institution currently approach financing for the coal transition?

- A. **Actively financing coal transition projects**
- B. Exploring financing opportunities but not actively investing
- C. Only considering projects with strong government backing.
- D. Not currently involved in coal transition financing

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing coal phaseout?

- A. **High cost and low profitability of coal phaseout**
- B. Limited bankable renewable energy projects
- C. Uncertainty in policy and regulations
- D. High transaction costs

5. What is the most challenging aspect of assessing transition finance risks?

- A. Unclear financial returns from coal transition projects
- B. **Limited successful case studies on coal-to-renewables transition**
- C. Difficulty in monitoring compliance with sustainability criteria
- D. Lack of standardized risk assessment frameworks

6. How concerned is your bank about potential defaults by coal plant operators undergoing transition?

- A. Highly concerned; significant credit risk
- B. Moderately concerned; risk varies by market
- C. **Slightly concerned; risk is manageable**
- D. Not concerned; strong risk mitigation measures in place

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your bank find most suitable for coal phase-out projects?

- A. Blended finance models
- B. Transition bonds
- C. Sustainability-linked loans
- D. **Green investment funds**

8. Would your bank consider participating in a Just Transition Fund to support the phaseout of coal?

- A. Yes, actively seeking opportunities
- B. **Possibly, if financial risks are mitigated**
- C. Not at this time, but open to future involvement
- D. No, not interested

9. What role does private capital play in your bank's coal transition strategy?

- A. Major role: we actively seek private-sector co-financing
- B. **Important, but requires de-risking measures**
- C. Limited: we primarily rely on public-sector guarantees
- D. Minimal: We prioritize government-backed projects

4. Government Policies & Incentives

10. What policy measure would most encourage your bank to finance the coal phaseout?

- A. **Government-backed guarantees and risk-sharing mechanisms**
- B. Carbon pricing and other regulatory drivers
- C. Direct financial incentives for renewable energy investments
- D. A combination of regulatory mandates and economic benefits

11. How do government policies in your bank's key operating markets influence your coal transition financing?

- A. **Strongly support coal phaseout financing**

- B. Provide some incentives but not sufficient
- C. Neutral; no clear direction
- D. Favor coal investments over transition projects

12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?

- A. Crucial: We require stable revenue guarantees
- B. Important but not the only factor**
- C. Somewhat important, but risk-sharing mechanisms matter more
- D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?

- A. Highly attractive
- B. Moderately attractive**
- C. Neutral
- D. Unattractive

14. Which Asian country presents the best investment opportunities for coal phaseout financing?

- A. Indonesia**
- B. Malaysia
- C. The Philippines
- D. Pakistan

15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?

- A. More attractive than traditional infrastructure projects
- B. About the same as other infrastructure investments**
- C. Less attractive but manageable with risk mitigation
- D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your bank to collaborate with international climate finance initiatives?

- A. Very willing; actively seeking partnerships**
- B. Somewhat willing; open to discussions
- C. Neutral; case-by-case basis
- D. Not interested

17. What kind of support would help your institution increase coal transition financing?

- A. Stronger policy incentives from governments
- B. Better risk mitigation tools from financial institutions**
- C. More standardized sustainability reporting frameworks
- D. Increased availability of blended finance options

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phase-out?

- A. Lack of technical expertise in transition finance
- B. Difficulties in structuring financial agreements**
- C. Unclear regulatory requirements
- D. Limited engagement with power plant operators

19. How does your bank track and assess the impact of coal transition projects?

- A. Using internal ESG performance indicators**
- B. Following external sustainability reporting standards
- C. Relying on third-party assessments

- D. We do not have a formal tracking system

8. Future Trends in Energy Transition Finance

20. Over the next 5 years, how do you see your institution's role in coal phaseout financing?
- A. **Significantly increasing involvement**
 - B. Gradually increasing participation
 - C. Maintaining current levels
 - D. Decreasing or exiting coal transition financing
21. How do you anticipate global energy market trends will impact your coal transition financing strategy?
- A. **Accelerating transition efforts**
 - B. Moderately influencing our strategy
 - C. Uncertain impact
 - D. Minimal influence
22. What emerging financing tool do you consider the most promising for the coal transition?
- A. **Carbon credits**
 - B. Transition loans
 - C. Green securitization
 - D. Debt-for-climate swaps
23. What is your bank's long-term stance on investments in fossil fuels?
- A. Phasing out all fossil fuel financing
 - B. **Focusing on cleaner fossil fuel alternatives (e.g., natural gas)**
 - C. Continuing fossil fuel investments with sustainability conditions
 - D. No change in the current investment strategy
24. Would your bank be interested in piloting innovative models for coal transition finance?
- A. Yes, we are actively looking for opportunities
 - B. Possibly, if risk-adjusted returns are favorable
 - C. **Not at this time, but open to future discussions**
 - D. No, we prefer traditional financing models.

Appendix 4: Questionnaire: Commercial Bank's Perspective on Financing the Coal Phaseout (4)

1. Institutional Policy on Coal Financing

1. Has your bank set a policy to phase out coal financing?
- A. Yes, we have a formal commitment with a clear timeline.
 - B. **We are considering it but have not set a timeline.**
 - C. We have no immediate plans to phase out coal financing.
 - D. We continue to finance coal projects with no restrictions.
2. What is the primary factor influencing your bank's approach to coal financing?
- A. **Regulatory requirements and government policies**
 - B. Market and investor pressure
 - C. Financial profitability of coal projects
 - D. Corporate sustainability commitments
3. How does your institution currently approach financing for the coal transition?
- A. Actively financing coal transition projects
 - B. Exploring financing opportunities but not actively investing
 - C. **Only considering projects with strong government backing.**
 - D. Not currently involved in coal transition financing

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing coal phaseout?
- A. High cost and low profitability of coal phaseout
 - B. Limited bankable renewable energy projects
 - C. **Uncertainty in policy and regulations**
 - D. High transaction costs
5. What is the most challenging aspect of assessing transition finance risks?
- A. Unclear financial returns from coal transition projects
 - B. Limited successful case studies on coal-to-renewables transition
 - C. **Difficulty in monitoring compliance with sustainability criteria**
 - D. Lack of standardized risk assessment frameworks
6. How concerned is your bank about potential defaults by coal plant operators undergoing transition?
- A. **Highly concerned; significant credit risk**
 - B. Moderately concerned; risk varies by market
 - C. Slightly concerned; risk is manageable
 - D. Not concerned; strong risk mitigation measures in place

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your bank find most suitable for coal phase-out projects?
- A. Blended finance models
 - B. Transition bonds
 - C. **Sustainability-linked loans**
 - D. Green investment funds
8. Would your bank consider participating in a Just Transition Fund to support the phaseout of coal?
- A. Yes, actively seeking opportunities
 - B. Possibly, if financial risks are mitigated
 - C. **Not at this time, but open to future involvement**
 - D. No, not interested
9. What role does private capital play in your bank's coal transition strategy?
- A. Major role: we actively seek private-sector co-financing
 - B. Important, but requires de-risking measures
 - C. **Limited: we primarily rely on public-sector guarantees**
 - D. Minimal: We prioritize government-backed projects

4. Government Policies & Incentives

10. What policy measure would most encourage your bank to finance the coal phaseout?
- A. **Government-backed guarantees and risk-sharing mechanisms**
 - B. Carbon pricing and other regulatory drivers
 - C. Direct financial incentives for renewable energy investments
 - D. A combination of regulatory mandates and economic benefits
11. How do government policies in your bank's key operating markets influence your coal transition financing?
- A. Strongly support coal phaseout financing
 - B. **Provide some incentives but not sufficient**
 - C. Neutral; no clear direction
 - D. Favor coal investments over transition projects
12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?
- A. Crucial: We require stable revenue guarantees
 - B. **Important but not the only factor**

- C. Somewhat important, but risk-sharing mechanisms matter more
- D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?
- A. Highly attractive
 - B. Moderately attractive
 - C. **Neutral**
 - D. Unattractive
14. Which Asian country presents the best investment opportunities for coal phaseout financing?
- A. Indonesia
 - B. Malaysia
 - C. The Philippines
 - D. Pakistan
 - E. **Case by Case**
15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?
- A. More attractive than traditional infrastructure projects
 - B. About the same as other infrastructure investments
 - C. **Less attractive but manageable with risk mitigation**
 - D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your bank to collaborate with international climate finance initiatives?
- A. Very willing; actively seeking partnerships
 - B. **Somewhat willing; open to discussions**
 - C. Neutral; case-by-case basis
 - D. Not interested
17. What kind of support would help your institution increase coal transition financing?
- A. **Stronger policy incentives from governments**
 - B. Better risk mitigation tools from financial institutions
 - C. More standardized sustainability reporting frameworks
 - D. Increased availability of blended finance options

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phase-out?
- A. **Lack of technical expertise in transition finance**
 - B. Difficulties in structuring financial agreements
 - C. Unclear regulatory requirements
 - D. Limited engagement with power plant operators
19. How does your bank track and assess the impact of coal transition projects?
- A. Using internal ESG performance indicators
 - B. Following external sustainability reporting standards
 - C. **Relying on third-party assessments**
 - D. We do not have a formal tracking system

8. Future Trends in Energy Transition Finance

20. Over the next 5 years, how do you see your institution's role in coal phaseout financing?
- A. Significantly increasing involvement
 - B. Gradually increasing participation

- C. **Maintaining current levels**
 - D. Decreasing or exiting coal transition financing
21. How do you anticipate global energy market trends will impact your coal transition financing strategy?
- A. Accelerating transition efforts
 - B. Moderately influencing our strategy
 - C. **Uncertain impact**
 - D. Minimal influence
22. What emerging financing tool do you consider the most promising for the coal transition?
- A. Carbon credits
 - B. **Transition loans**
 - C. Green securitization
 - D. Debt-for-climate swaps
23. What is your bank's long-term stance on investments in fossil fuels?
- A. Phasing out all fossil fuel financing
 - B. **Focusing on cleaner fossil fuel alternatives (e.g., natural gas)**
 - C. Continuing fossil fuel investments with sustainability conditions
 - D. No change in the current investment strategy
24. Would your bank be interested in piloting innovative models for coal transition finance?
- A. Yes, we are actively looking for opportunities
 - B. Possibly, if risk-adjusted returns are favorable
 - C. **Not at this time, but open to future discussions**
 - D. No, we prefer traditional financing models.

Appendix 5: Questionnaire: Policy Bank's Perspective on Financing the Coal Phaseout (1)

1. Institutional Policy on Phase-out of Coal Financing

1. Has your bank established a policy to phase out coal financing?
 - A. Yes, with a formal commitment and clear timeline.
 - B. We are considering it, but have not set a timeline.
 - C. **We have no immediate plans to phase out coal financing.**
 - D. We continue financing coal projects with no restrictions.
2. What is the primary factor influencing your bank's approach to coal financing?
 - A. **National energy and economic policies (Primary)**
 - B. **International climate commitments (Secondary)**
 - C. **Financial sustainability of coal projects (Secondary)**
 - D. **Developmental priorities and energy security (Primary)**
 - E. Other.....
3. How does your institution currently support the coal transition?
 - A. **Actively financing transition projects as a priority**
 - B. Exploring opportunities but not actively investing
 - C. Only financing projects with strong government directives
 - D. Not currently involved in coal transition financing

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing the coal phaseout?
 - A. High cost and low profitability of the coal phaseout
 - B. **Limited bankable renewable energy projects (Limited renewable energy projects)**
 - C. Uncertainty in policy and regulations
 - D. High transaction costs

E. Other.....

5. What is the most challenging aspect of assessing transition finance risks?
- A. Unclear financial returns from coal transition projects
 - B. Limited successful case studies on coal-to-renewables transition
 - C. Difficulty in monitoring compliance with sustainability criteria
 - D. Lack of standardized risk assessment frameworks
 - E. **Other: Maintaining the local employment, regional economy, and industry is the main challenge for transition.**
6. How concerned is your bank about potential defaults by coal plant operators undergoing transition?
- A. Highly concerned; significant credit risk
 - B. Moderately concerned; risk varies by market
 - C. Slightly concerned; risk is manageable
 - D. **Not concerned; strong risk mitigation measures in place**

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your bank find most suitable for coal phase-out projects?
- A. Public-private partnerships (PPPs)
 - B. Concessional loans
 - C. Green and transition bonds
 - D. **Blended finance models**
 - E. **Other: Governmental support in the form of subsidies.**
8. Would your bank consider participating in a Just Transition Fund to support the phaseout of coal?
- A. Yes, actively seeking opportunities
 - B. **Possibly, if financial risks are mitigated**
 - C. Not at this time, but open to future involvement
 - D. No, not interested
9. What role does private capital play in your bank's coal transition strategy?
- A. **Major role: We actively seek private-sector co-financing**
 - B. Important, but requires de-risking measures
 - C. Limited: We primarily rely on government funding
 - D. Minimal: We focus on state-led initiatives

4. Government Policies & Incentives

10. What policy measure would most encourage your bank to finance the coal phaseout?
- A. **Government-backed guarantees and risk-sharing mechanisms**
 - B. **Carbon pricing and other regulatory drivers**
 - C. Direct financial incentives for renewable energy investments
 - D. A combination of regulatory mandates and economic benefits
 - E. Other.....
11. How do government policies in your bank's key operating markets influence coal transition financing?
- A. **Strongly support coal phaseout financing**
 - B. Provide some incentives but not sufficient
 - C. Neutral; no clear direction
 - D. Favor coal investments over transition projects
12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?
- A. **Crucial: We require stable revenue guarantees (Primary)**
 - B. **Important but not the only factor (Secondary)**
 - C. Somewhat important, but risk-sharing mechanisms matter more
 - D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?
 - A. Highly attractive
 - B. **Moderately attractive**
 - C. Neutral
 - D. Unattractive
14. Which Asian country presents the best investment opportunities for coal phaseout financing?
 - A. **Indonesia**
 - B. Malaysia
 - C. The Philippines
 - D. Pakistan
 - E. Other.....
15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?
 - A. **More attractive than traditional infrastructure projects**
 - B. About the same as other infrastructure investments
 - C. Less attractive but manageable with risk mitigation
 - D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your bank to collaborate with international climate finance initiatives?
 - A. Very willing; actively seeking partnerships
 - B. **Somewhat willing; open to discussions**
 - C. Neutral; case-by-case basis
 - D. Not interested
17. What kind of support would help your institution increase coal transition financing?
 - A. **Stronger policy incentives from governments**
 - B. Better risk mitigation tools from financial institutions
 - C. More standardized sustainability reporting frameworks
 - D. Increased availability of blended finance options
 - E. Other.....

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phaseout?
 - A. **Lack of technical expertise in transition finance**
 - B. Difficulties in structuring financial agreements
 - C. Unclear regulatory requirements
 - D. Limited engagement with power plant operators
 - E. Other.....
19. How does your bank track and assess the impact of coal transition projects?
 - A. **Using internal ESG performance indicators**
 - B. Following external sustainability reporting standards
 - C. Relying on third-party assessments
 - D. We do not have a formal tracking system
 - E. Other.....

8. Future Trends in Energy Transition Finance

20. Over the next five years, how do you see your institution's role in coal phaseout financing?
 - A. Significantly increasing involvement
 - B. **Gradually increasing participation**
 - C. Maintaining current levels
 - D. Decreasing or exiting coal transition financing
21. How do you anticipate global energy market trends will impact your coal transition financing strategy?
 - A. **Accelerating transition efforts**
 - B. Moderately influencing our strategy

- C. Uncertain impact
 - D. Minimal influence
22. What emerging financing tool do you consider the most promising for the coal transition?
- A. **Carbon credits**
 - B. **Transition loans**
 - C. Green securitization
 - D. Debt-for-climate swaps
 - E. Other.....
23. What is your bank's long-term stance on investments in fossil fuels?
- A. Phasing out all fossil fuel financing
 - B. **Focusing on cleaner fossil fuel alternatives (e.g., natural gas)**
 - C. **Continuing fossil fuel investments with sustainability conditions**
 - D. No change in the current investment strategy
24. Would your bank be interested in piloting innovative models for financing the transition from coal?
- A. **Yes, we are actively looking for opportunities**
 - B. Possibly, if risk-adjusted returns are favorable
 - C. Not at this time, but open to future discussions
 - D. No, we prefer traditional financing models
25. What role do you believe philanthropy can play in supporting the coal phase-out?
- A. Crucial: a key driver of funding and risk reduction
 - B. **Supportive: complements public and private financing**
 - C. Limited: plays a minor role in the transition
 - D. No role: not relevant to coal phase-out financing

Appendix 6: Questionnaire: Policy Bank's Perspective on Financing the Coal Phaseout (2)

1. Institutional Policy on Phase-out of Coal Financing

1. Has your bank established a policy to phase out coal financing?
 - A. Yes, with a formal commitment and clear timeline.
 - B. We are considering it, but have not set a timeline.
 - C. **We have no immediate plans to phase out coal financing.**
 - D. We continue financing coal projects with no restrictions.
2. What is the primary factor influencing your bank's approach to coal financing?
 - A. **National energy and economic policies (Primary)**
 - B. **International climate commitments (Secondary)**
 - C. **Financial sustainability of coal projects (Secondary)**
 - D. **Developmental priorities and energy security (Primary)**
 - E. Other.....
3. How does your institution currently support the coal transition?
 - A. **Actively financing transition projects as a priority**
 - B. Exploring opportunities but not actively investing
 - C. Only financing projects with strong government directives
 - D. Not currently involved in coal transition financing

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing the coal phaseout?
 - A. High cost and low profitability of the coal phaseout
 - B. **Limited bankable renewable energy projects (Limited renewable energy projects)**
 - C. Uncertainty in policy and regulations
 - D. High transaction costs
 - E. Other.....
5. What is the most challenging aspect of assessing transition finance risks?
 - A. Unclear financial returns from coal transition projects
 - B. Limited successful case studies on coal-to-renewables transition
 - C. Difficulty in monitoring compliance with sustainability criteria
 - D. Lack of standardized risk assessment frameworks
 - E. **Other: Maintaining the local employment, regional economy, and industry is the main challenge for transition.**
6. How concerned is your bank about potential defaults by coal plant operators undergoing transition?
 - A. Highly concerned; significant credit risk
 - B. Moderately concerned; risk varies by market
 - C. Slightly concerned; risk is manageable
 - D. **Not concerned; strong risk mitigation measures in place**

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your bank find most suitable for coal phase-out projects?
 - A. Public-private partnerships (PPPs)
 - B. Concessional loans
 - C. Green and transition bonds
 - D. **Blended finance models**
 - E. **Other: Governmental support in the form of subsidies.**
8. Would your bank consider participating in a Just Transition Fund to support the phaseout of coal?
 - A. Yes, actively seeking opportunities
 - B. **Possibly, if financial risks are mitigated**

- C. Not at this time, but open to future involvement
- D. No, not interested

9. What role does private capital play in your bank's coal transition strategy?
- A. **Major role: We actively seek private-sector co-financing**
 - B. Important, but requires de-risking measures
 - C. Limited: We primarily rely on government funding
 - D. Minimal: We focus on state-led initiatives

4. Government Policies & Incentives

10. What policy measure would most encourage your bank to finance the coal phaseout?
- A. **Government-backed guarantees and risk-sharing mechanisms**
 - B. **Carbon pricing and other regulatory drivers**
 - C. Direct financial incentives for renewable energy investments
 - D. A combination of regulatory mandates and economic benefits
 - E. Other.....
11. How do government policies in your bank's key operating markets influence coal transition financing?
- A. **Strongly support coal phaseout financing**
 - B. Provide some incentives but not sufficient
 - C. Neutral; no clear direction
 - D. Favor coal investments over transition projects
12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?
- A. **Crucial: We require stable revenue guarantees (Primary)**
 - B. **Important but not the only factor (Secondary)**
 - C. Somewhat important, but risk-sharing mechanisms matter more
 - D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?
- A. Highly attractive
 - B. **Moderately attractive**
 - C. Neutral
 - D. Unattractive
14. Which Asian country presents the best investment opportunities for coal phaseout financing?
- A. **Indonesia**
 - B. Malaysia
 - C. The Philippines
 - D. Pakistan
 - E. Other.....
15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?
- A. **More attractive than traditional infrastructure projects**
 - B. About the same as other infrastructure investments
 - C. Less attractive but manageable with risk mitigation
 - D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your bank to collaborate with international climate finance initiatives?
- A. Very willing; actively seeking partnerships
 - B. **Somewhat willing; open to discussions**
 - C. Neutral; case-by-case basis
 - D. Not interested
17. What kind of support would help your institution increase coal transition financing?

- A. **Stronger policy incentives from governments**
- B. Better risk mitigation tools from financial institutions
- C. More standardized sustainability reporting frameworks
- D. Increased availability of blended finance options
- E. Other.....

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phaseout?
- A. **Lack of technical expertise in transition finance**
 - B. Difficulties in structuring financial agreements
 - C. Unclear regulatory requirements
 - D. Limited engagement with power plant operators
 - E. Other.....
19. How does your bank track and assess the impact of coal transition projects?
- A. **Using internal ESG performance indicators**
 - B. Following external sustainability reporting standards
 - C. Relying on third-party assessments
 - D. We do not have a formal tracking system
 - E. Other.....

8. Future Trends in Energy Transition Finance

20. Over the next five years, how do you see your institution's role in coal phaseout financing?
- A. Significantly increasing involvement
 - B. **Gradually increasing participation**
 - C. Maintaining current levels
 - D. Decreasing or exiting coal transition financing
21. How do you anticipate global energy market trends will impact your coal transition financing strategy?
- A. **Accelerating transition efforts**
 - B. Moderately influencing our strategy
 - C. Uncertain impact
 - D. Minimal influence
22. What emerging financing tool do you consider the most promising for the coal transition?
- A. **Carbon credits**
 - B. **Transition loans**
 - C. Green securitization
 - D. Debt-for-climate swaps
 - E. Other.....
23. What is your bank's long-term stance on investments in fossil fuels?
- A. Phasing out all fossil fuel financing
 - B. **Focusing on cleaner fossil fuel alternatives (e.g., natural gas)**
 - C. **Continuing fossil fuel investments with sustainability conditions**
 - D. No change in the current investment strategy
24. Would your bank be interested in piloting innovative models for financing the transition from coal?
- A. **Yes, we are actively looking for opportunities**
 - B. Possibly, if risk-adjusted returns are favorable
 - C. Not at this time, but open to future discussions
 - D. No, we prefer traditional financing models
25. What role do you believe philanthropy can play in supporting the coal phase-out?
- A. Crucial: a key driver of funding and risk reduction
 - B. **Supportive: complements public and private financing**
 - C. Limited: plays a minor role in the transition
 - D. No role: not relevant to coal phase-out financing

Appendix 7: Questionnaire: MDB's Perspective on Financing the Coal Phaseout (1)

1. Institutional Policy on Phase out Coal Financing

1. Has your institution established a policy to phase out coal financing?
 - A. Yes, with a formal commitment and clear timeline.
 - B. We are considering it but have not set a timeline.
 - C. We have no immediate plans to phase out coal financing.
 - D. We continue financing coal projects with no restrictions.
 - E. **Phase-out coal financing is a part of the transition policy. - While not explicitly delineated, it constitutes a component of their operations. However, they have not identified any specific elements for phasing out coal; rather, their focus is predominantly on transition finance.**
2. What is the primary factor influencing your institution's approach to coal financing?
 - A. National energy policies and economic priorities
 - B. International climate commitments and agreements
 - C. Financial sustainability of coal projects
 - D. Developmental priorities and energy security considerations
 - E. **Other..... All of these are factors; they vary by country and client, so they cannot determine what the primary factor is. Factors A to D are all important. For example, in Indonesia, the key elements would be the financial arrangement and the fairness of the phase-out package, so it depends. It is necessary to consider national policies and priorities.**
3. How does your institution currently support the coal transition?
 - A. **Actively financing transition projects as a priority**
 - B. Exploring opportunities but not actively investing
 - C. Only financing projects with strong government directives
 - D. Not currently involved in coal transition financing
 - E. **As for us, the inquiry should come from the government. Financial projects with strong government directives. (A+Government Support)**

For them to be actively involved, they will need government involvement; A and C are not mutually exclusive.

2. Financial Risks and Barriers

4. What is the most significant financial risk associated with financing the coal phaseout?
 - A. **High cost and low profitability of coal phaseout**
 - B. Limited bankable renewable energy projects
 - C. **Uncertainty in policy and regulations**
 - D. High transaction costs
 - E. **Other..... Institutional quality-related issues.**
5. What is the most challenging aspect of assessing transition finance risks?
 - A. **Unclear financial returns from coal transition projects**
 - B. **Limited successful case studies on coal-to-renewables transition**
 - C. Difficulty in monitoring compliance with sustainability criteria
 - D. **Lack of standardized risk assessment frameworks**
 - E. Other.....
6. How concerned is your institution about potential defaults by coal plant operators undergoing transition?
 - A. Highly concerned; significant credit risk
 - B. Moderately concerned; risk varies by market
 - C. Slightly concerned; risk is manageable
 - D. Not concerned; strong risk mitigation measures in place
 - E. **The government absorbs operational risks, and the client is not the operator. (doesn't apply)**

3. Financing Mechanisms & Strategies

7. Which financing mechanism does your institution find most suitable for coal phase-out projects?

- A. **Public-private partnerships (PPPs)**
- B. **Concessional loans**
- C. Green and transition bonds
- D. **Blended finance models**
- E. Other.....

8. Would your institution consider participating in a Just Transition Fund to support the phaseout of coal?
- A. Yes, actively seeking opportunities
 - B. Possibly, if financial risks are mitigated
 - C. Not at this time, but open to future involvement
 - D. No, not interested
 - E. **Possibly, but our job is to mitigate financial risk, so that is not a consideration.**

9. What role does private capital play in your institution's coal transition strategy?
- A. Major role: We actively engage private-sector co-financing
 - B. Important, We rely on private capital, supported by de-risking measures
 - C. Limited: We primarily depend on government or concessional funding
 - D. Minimal: Our focus is on state-led or multilateral initiatives
 - E. **We use concessional funding to encourage more private capital to participate.**

4. Government Policies & Incentives

10. What policy measure would most encourage your institution to finance the coal phaseout?
- A. Guarantees and risk-sharing mechanisms
 - B. Carbon pricing and other regulatory drivers
 - C. Direct financial incentives for renewable energy investments
 - D. A combination of regulatory mandates and economic benefits
 - E. **Other..... Not applicable.**

11. How do government policies in your institution's key operating markets influence coal transition financing?
- A. **Strongly support coal phaseout financing**
 - B. Provide some incentives but not sufficient
 - C. Neutral; no clear direction
 - D. Favor coal investments over transition projects

12. How does the availability of long-term power purchase agreements (PPAs) for post-coal transition projects impact your financing decisions?
- A. Crucial: We require stable revenue guarantees
 - B. **Important but not the only factor**
 - C. Somewhat important, but risk-sharing mechanisms matter more
 - D. Not a significant factor in decision-making

5. Market & Investment Climate

13. How do you assess the investment climate for coal transition projects in Asia?
- A. Highly attractive
 - B. Moderately attractive
 - C. **Neutral**
 - D. Unattractive
14. Which Asian country presents the best investment opportunities for coal phaseout financing?
- A. **Indonesia**
 - B. Malaysia
 - C. **The Philippines**
 - D. Pakistan
 - E. Other.....

15. How does the risk-return profile of coal transition projects compare to other infrastructure investments?
- A. More attractive than traditional infrastructure projects

- B. **About the same as other infrastructure investments**
- C. Less attractive but manageable with risk mitigation
- D. Significantly less attractive

6. Collaboration & Future Outlook

16. How willing is your institution to collaborate with international climate finance initiatives?
- A. **Very willing; actively seeking partnerships**
 - B. Somewhat willing; open to discussions
 - C. Neutral; case-by-case basis
 - D. Not interested
17. What kind of support would help your institution increase coal transition financing?
- A. **Stronger policy incentives from governments**
 - B. **Better risk mitigation tools from financial institutions**
 - C. **More standardized sustainability reporting frameworks**
 - D. Increased availability of blended finance options
 - E. Other.....

7. Technical & Operational Challenges

18. What is the most significant operational challenge associated with financing the coal phaseout?
- A. **Lack of technical expertise in transition finance**
 - B. **Difficulties in structuring financial agreements**
 - C. **Unclear regulatory requirements**
 - D. Limited engagement with power plant operators
 - E. Other.....
19. How does your institution track and assess the impact of coal transition projects?
- A. Using internal ESG performance indicators
 - B. Following external sustainability reporting standards
 - C. Relying on third-party assessments
 - D. We do not have a formal tracking system
 - E. **Other..... Internal Assessment Mechanism**

8. Future Trends in Energy Transition Finance

20. Over the next five years, how do you see your institution's role in coal phaseout financing?
- A. Significantly increasing involvement
 - B. Gradually increasing participation
 - C. **Maintaining current levels**
 - D. Decreasing or exiting coal transition financing
21. How do you anticipate global energy market trends will impact your coal transition financing strategy?
- A. Accelerating transition efforts
 - B. Moderately influencing our strategy
 - C. **Uncertain impact**
 - D. Minimal influence
22. What emerging financing tool do you consider the most promising for the coal transition?
- A. **Carbon credits**
 - B. Transition loans
 - C. Green securitization
 - D. Debt-for-climate swaps
 - E. Other.....
23. What is your institution's long-term stance on investments in fossil fuels?
- A. Phasing out all fossil fuel financing
 - B. Focusing on cleaner fossil fuel alternatives (e.g., natural gas)
 - C. Continuing fossil fuel investments with sustainability conditions

D. No change in the current investment strategy

24. Would your institution be interested in piloting innovative models for financing the transition from coal?
- A. **Yes, we are actively looking for opportunities**
 - B. Possibly, if risk-adjusted returns are favorable
 - C. Not at this time, but open to future discussions
 - D. No, we prefer traditional financing models
25. What role do you believe philanthropy can play in supporting the coal phase-out?
- A. Crucial: a key driver of funding and risk reduction
 - B. **Supportive: complements public and private financing**
 - C. Limited: plays a minor role in the transition
 - D. No role: not relevant to coal phase-out financing

Appendix 8: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Bangladesh – Rampal Coal Power Plant

Section 1: Information about the Plant Owner and Selected Plant

Plant Name: Rampal 1320 MW (BIFPCL) Coal Power Plant

Location (Division): Bagerhat

Type of Plant:

- Coal-fired
- Other (please specify)

Installed Capacity (MW): 1320

Combustion Type: coal

Commissioning Year: 2022

Ownership:

- Public
- Private
- Joint (Public-Private)

Section 2: Overarching Questions:

Have you considered retiring the coal power plant you own earlier than planned? If yes, what are the long-term risks or factors that make you concerned?

- External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
- National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
- Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
- Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)
- Other (please specify)

As a plant owner, what are the top 3 biggest challenges in transitioning from coal power generation?

- Internal investment incentives
- Expected Internal Rate of Return (IRR) on Continued Operations
- Changing longstanding business practices and mindsets
- Additional costs due to plant retirement
- Existing regulatory/contractual obligations
- Infrastructural constraints in the power system and grid
- Insufficient technical skills and capacities
- Impact on local communities, including plant workers
- Others...

What are the major factors to consider when choosing/prioritizing retirement of coal power plants?

- Outstanding loans of plants
- **Remaining lifespans of plants**
- Revenue / net profit of plants
- Impact to the local electric grid (energy security and stability)
- ...

What is the existing preference and projected trend in coal and renewable energy investment in the country/division?

Coal continues to be regarded as a significant component in ensuring the country's energy security, given its availability, reliability, and role in maintaining a stable base-load power supply amidst growing energy demand.

Section 3: Economic and Financial Barriers

What are the key economic barriers to early retirement of this particular coal power plant?

- Decommissioning costs
- Lost revenue from the plant's operations
- **Need for compensation to shareholders or investors**
- Costs of shutting down supply chains
- Other (please specify)

What financial risks are most significant for the plant owners if the plant is retired early?

- Loss of investment returns
- **Devaluation of plant assets**
- Impact on financial contracts or PPAs
- Other (please specify)

What financing challenges do plant owners face in transitioning from coal to renewable energy?

- Difficulty in securing loans for renewable investments
- **Inability to access low-interest or green financing**
- Lack of trust from financial institutions in renewable projects
- The profit of renewable energy projects
- Other (please specify)

Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?

- Yes
- **No**
- If yes, how effective have these instruments been?

What are the barriers to accessing international climate finance or green investment for this plant's transition?

- Complex application processes
- **Insufficient knowledge or awareness of available funding**
- Risk perception by international investors
- Other (please specify)

How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?

- Government-backed guarantees
- Risk-sharing agreements
- Climate insurance products
- Other (please specify)

Section 4: Incentives for Coal Plant Owners

What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?

- Tax credits or subsidies for renewable energy projects
- Performance-based incentives
- Low-interest loans or grants
- Other (please specify)

How could investors be incentivized to fund the transition of this coal plant to renewable energy?

- Guaranteed returns from renewable energy investments
- Reduced risk through government-backed schemes
- Other (please specify)

What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

Carbon pricing mechanisms, such as carbon taxes or emissions trading systems, can significantly influence the financial viability of coal-fired power plants like the Rampal Power Plant in Bangladesh. These mechanisms assign a monetary cost to carbon emissions, thereby increasing the operational expenses of high-emission facilities.

Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

There are both local and international investment funds that could support the transition of coal plants like the Rampal Power Plant to renewable energy. Internationally, mechanisms such as the *Green Climate Fund (GCF)*, *Climate Investment Funds (CIF)*, and the *Just Energy Transition Partnership (JETP)* offer financial support for shifting from coal to clean energy, especially in developing countries. Regionally, institutions like the *Asian Development Bank (ADB)* have expressed interest in funding early coal retirement and renewable integration projects. Locally, financing could also come from blended finance models involving *Bangladesh Infrastructure Finance Fund Limited (BIFFL)* and public-private partnerships, provided there is strong policy alignment and political will.

Section 5: Energy Security and Infrastructure

What energy security concerns are associated with retiring this coal plant early?

- Impact on grid stability and reliability
- Availability of renewable energy sources to meet demand
- Capacity for energy storage solutions
- Other (please specify)

How could Bangladesh's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?

Bangladesh's energy infrastructure would need targeted upgrades in grid capacity, flexibility, and storage to accommodate renewable energy from the closure of the Rampal coal plant. Key steps include: Grid Modernization, Investment in Energy Storage, Distributed Renewable Deployment, Transmission Expansion, Regulatory Reform

What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?

Stable Transmission Grid

Section 6: Social and Workforce Considerations

How would local communities be impacted by the early retirement of this coal power plant? Losing job

What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)? Economic decline Section 7: Policy and Regulatory Barriers

What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?

Absence of a Just Transition Policy for coal phase-out, Rigid long-term PPAs limiting plant flexibility, Weak incentives for large-scale renewable investments, Grid capacity and access issues for renewable integration, Limited access to international climate finance due to regulatory hurdles. Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables? Renewable energy policy

What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

Green Climate Fund

Section 7: Role of Foreign Investment and International Support (4 Questions)

What role do foreign investments play in the financing of this coal plant's transition to renewable energy?

Provide capital for early coal retirement and renewable energy deployment, Enable access to low-interest green finance from institutions like ADB, GCF, and World Bank.

What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?

GCF

How can foreign investors be incentivized to support the early retirement of coal plants in Bangladesh?

- By offering guarantees or risk-sharing mechanisms
- Through policy frameworks that support long-term stability
- Other (please specify)

What challenges exist in attracting foreign investment for coal-to-renewables transitions in Bangladesh?

- Political risk or instability
- Risk of insufficient return on investment
- Regulatory uncertainty
- Other (please specify)

What aspects of foreign examples in their transition experience would you like to learn more about?

- Policy & regulation
- Financial incentives
- Decommissioning procedures
- Other (please specify)

Appendix 9: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Bangladesh – Barapukuria Coal Mine

Section 1: Information about the Plant Owner and Selected Plant

Plant Name: Barapukuria Coal Mine

Location (Division): Dinajpur

Type of Plant:

- Coal-fired
- Other (please specify)

Installed Capacity (MW): 520

Combustion Type: coal

Commissioning Year: 2006 and 2017

Ownership:

- **Public**
- Private
- Joint (Public-Private)

Section 2: Overarching Questions:

Have you considered retiring the coal power plant you own earlier than planned? If yes, what are the long-term risks or factors that make you concerned?

- External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
- National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
- **Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)**
- Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)

As a plant owner, what are the top 3 biggest challenges in transitioning from coal power generation?

- Internal investment incentives
- Expected Internal Rate of Return (IRR) on Continued Operations
- Changing longstanding business practices and mindsets
- **Additional costs due to plant retirement**
- Existing regulatory/contractual obligations
- Infrastructural constraints in the power system and grid
- **Insufficient technical skills and capacities**
- **Impact on local communities, including plant workers**

What are the major factors to consider when choosing/prioritizing retirement of coal power plants?

- Outstanding loans of plants
- **Remaining lifespans of plants**
- Revenue / net profit of plants
- Impact to the local electric grid (energy security and stability)

What is the existing preference and projected trend in coal and renewable energy investment in the country/division?

Coal is still considered as one of the important parameter for the energy security of the country

Section 3: Economic and Financial Barriers

What are the key economic barriers to early retirement of this particular coal power plant?

- Decommissioning costs
- **Lost revenue from the plant's operations**
- Need for compensation to shareholders or investors
- Costs of shutting down supply chains
- Other (please specify)

What financial risks are most significant for the plant owners if the plant is retired early?

- Loss of investment returns
- **Devaluation of plant assets**
- Impact on financial contracts or PPAs
- Other (please specify)

What financing challenges do plant owners face in transitioning from coal to renewable energy?

- Difficulty in securing loans for renewable investments
- Inability to access low-interest or green financing
- **Lack of trust from financial institutions in renewable projects**
- The profit of renewable energy projects
- Other (please specify)

Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?

- Yes
- **No**
- If yes, how effective have these instruments been?

What are the barriers to accessing international climate finance or green investment for this plant's transition?

- Complex application processes
- Insufficient knowledge or awareness of available funding
- **Risk perception by international investors**
- Other (please specify)

How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?

- **Government-backed guarantees**
- Risk-sharing agreements
- Climate insurance products
- Other (please specify)

Section 4: Incentives for Coal Plant Owners

What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?

- Tax credits or subsidies for renewable energy projects
- **Performance-based incentives**
- Low-interest loans or grants
- Other (please specify)

How could investors be incentivized to fund the transition of this coal plant to renewable energy?

- Guaranteed returns from renewable energy investments
- **Reduced risk through government-backed schemes**
- Other (please specify)

What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

Less influence

Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

Not yet

Section 5: Energy Security and Infrastructure

What energy security concerns are associated with retiring this coal plant early?

- Impact on grid stability and reliability
- **Availability of renewable energy sources to meet demand**
- Capacity for energy storage solutions
- Other (please specify)

How could Bangladesh's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?

When better renewable technologies offer lower price of electricity

What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?

Transmission line

Section 6: Social and Workforce Considerations

How would local communities be impacted by the early retirement of this coal power plant?

Loosing job

What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?

Alternative job and financial support

Section 7: Policy and Regulatory Barriers

What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?

Shifting of assets and manpower of the coal power plant

Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?

Renewable energy policy

What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

Financial support

Section 8: Role of Foreign Investment and International Support (4 Questions)

What role do foreign investments play in the financing of this coal plant's transition to renewable energy?

Offer smooth transition of human resources and alternative energy sources

What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?

GCF

How can foreign investors be incentivized to support the early retirement of coal plants in Bangladesh?

- By offering guarantees or risk-sharing mechanisms
- Through policy frameworks that support long-term stability
- Other (please specify)

What challenges exist in attracting foreign investment for coal-to-renewables transitions in Bangladesh?

- Political risk or instability
- Risk of insufficient return on investment
- Regulatory uncertainty
- Other (please specify)

What aspects of foreign examples in their transition experience would you like to learn more about?

- Policy & regulation
- Financial incentives
- Decommissioning procedures
- Other (please specify)

Appendix 10: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Indonesia – PT. PLN Indonesia Power

Section 1: Information about the Plant Owner and Selected Plant

Plant Owner Name: PT. PLN Indonesia Power
Key Informant: Mr. Bernadus Sudarmanta
Director of Business Development and Commerce

Plant Owner's fuel mix for power generation (in % of total Installed Capacity) in the Country and Province in 2024 (or 2023, if 2024 data not yet available)¹:

Fuel Mix	Coal %	Gas %	Wind %	Solar %	Other (please specify) % Diesel, Hydro, Biomass,	Total
Country	49,765 (54,6%)	23,208 (25,4%)	152 (0,06%)	598 (0,65%)	17,441 (19.1%)	91,164 (100%)
Province	9072 (90,6%)	889 (8,8%)	-	2 (0,02%)	46 (4,6%)	10,009 100%

Note: a because Sularaya power plant in Banten Province

Plant Owner's power generation contribution (power market share) in the Country, and in the province in 2024 (or 2023, if 2024 data not yet available):

	Power market share (%)
Country	10
Province	91.1

In 2023 installed capacity of IP was about 9,124.72 MW²

What is the Plant Owner's transition strategy?

Throughout 2021, the Company has realized the energy transition through the development of renewable energy power plants by completing the construction of the Gunung Wugul PLTM / Microhydro (3 MW), Grati Landbase PLTS / Solar PV (1.5 MWp), and Nusa Penida Hybrid PLTS (3.5 MWp). In addition, in achieving the renewable energy mix, in 2022 PLN Indonesia Power has commercialized cofiring at 11 PLTUs / Coal Fire Power Plant, namely Suralaya 1-4 PLTUs, Suralaya 5-7 PLTUs, Suralaya 8 PLTUs, Labuan PLTUs, Lontar PLTUs, Pelabuhan Ratu PLTUs, Adipala PLTUs, Sanggau PLTUs, Sintang PLTUs, Jeranjang PLTUs and Barru PLTUs which have an impact on increasing renewable energy production in the energy mix.

What is the Plant Owner's emission reduction target?

"PLN Indonesia Power owns and manages power plants with green and clean energy, including geothermal steam in PLTP, water in PLTA and PLTM and sunlight in PLTS, amounting to 1,510 MW +5 MWp. Furthermore, PLN

¹ https://gatrik.esdm.go.id/assets/uploads/download_index/files/e6394-buku-statistik-ketenagalistrikan-2023-esdm-revised.pdf

² <https://www.plnindonesiapower.co.id/id/komunikasi-berkelanjutan/Reports/ANNUAL%20REPORT%20PT%20PLN%20INDONESIA%20POWER%20TAHUN%202023.pdf>

Indonesia Power contributes to the acceleration of the EBT mix in Indonesia through the development of EBT power plants and Co-firing PLTU, so that it is expected that the new and renewable energy mix in PLN Indonesia Power will reach 30% of the total installed capacity of the power plants managed in 2028”³.

Plant Name: Generation Business Unit Suralaya (8 Units)

Location (Provinces /Region): Cilegon (Banten)

Type of Plant:

- Coal-fired

Installed Capacity (MW): 4,025⁴ (Note: The first phase operated in 1984 with two units with a capacity of 400 MW each; the second phase operated in 1989 with two units with a capacity of 400 MW each; the third phase was developed with three units with a capacity of 600 MW. Then the 8th unit will operate again, with a capacity of 625 MW. Thus, in Cilegon there are eight units of fire coal power plants.

Combustion Type: Coal Fired Power Plant

Commissioning Year:

Ownership:

- Public (PT. PLN)
- Annual Power Generation (MWh): 84,199.86 GWh⁵
Expected Lifespan (years remaining): -
Major Financial Stakeholders (Banks, Investors): PT. PLN

Section 2: Overarching Questions:

Have you considered retiring the coal power plant you own earlier than planned? If yes, what are the long-term risks or factors that make you concerned?

- External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
- National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
- Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
- Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)
- **Other (please specify)**

Yes, especially for the Suralaya steam coal power plant (PLTU) units I to IV because the age of this power plant is already very old (Suralaya has 10 units). In 1984, two PLTU power plants with a capacity of 400 MW each were built; and in 1989 two other units with the same capacity were also built. Thus, if Suralaya

³ <https://www.plnindonesiapower.co.id/id/komunikasi-berkelanjutan/Reports/ANNUAL%20REPORT%20PT%20PLN%20INDONESIA%20POWER%20TAHUN%202023.pdf>

⁴ <https://www.plnindonesiapower.co.id/id/komunikasi-berkelanjutan/Reports/ANNUAL%20REPORT%20PT%20PLN%20INDONESIA%20POWER%20TAHUN%202023.pdf>

⁵ <https://www.plnindonesiapower.co.id/id/komunikasi-berkelanjutan/Reports/ANNUAL%20REPORT%20PT%20PLN%20INDONESIA%20POWER%20TAHUN%202023.pdf>

I-IV must be retired, it is necessary to replace renewable energy with a total capacity of 4 x 4.00 MW = 1,600 MW and currently it is very possible with the support of solar PV equipped with batteries.

However, the Suralaya PLTU is a basic load bearer and can make a significant contribution to the business margin. Currently, the Cost of Provision (BPP) is also below the electricity tariff, so that the Suralaya PLTU contributes to reducing the burden of electricity subsidies⁶. If the retirement of Suralaya does not have an impact on these things, this will be.

As a plant owner, what are the top three biggest challenges in transitioning from coal power generation?

- **Internal investment incentives**
- Expected Internal Rate of Return (IRR) on Continued Operations
- Changing longstanding business practices and mindsets
- Additional costs due to plant retirement
- **Existing regulatory/contractual obligations**
- Infrastructural constraints in the power system and grid
- Insufficient technical skills and capacities
- Impact on local communities, including plant workers.
- Others...

The leverage conditions for the energy transition are still constrained by several factors. First, the existence of hidden subsidies for coal. The price of coal is cheap due to the domestic market obligation (DMO) policy. The current DMO policy is based on the Decree of the Minister of Energy and Mineral Resources No. 399.K/MB.01/MEM.B/2023 concerning Amendments to the Decree of the Minister of Energy and Mineral Resources No. 267.K/MB.01/MEM.B/2022 concerning the Fulfillment of Domestic Coal Needs. The government sets the amount of DMO at 25% of the realization of coal production in the current year. Companies that violate this provision are subject to sanctions in the form of an obligation to pay compensation funds. Furthermore, if the compensation funds are not paid, administrative sanctions will be imposed in the form of a ban on the sale of coal abroad for 30 days until the mining business license is revoked. Furthermore, the government also sets the benchmark price for coal for PLN's needs at US\$ 70 per ton (this price policy has not changed since 2018). DMO policy is a form of indirect subsidy for coal. This is likely done by the government so that the amount of electricity subsidy can be controlled. On the other hand, coal entrepreneurs are facing the government adjusting the DMO price considering the global coal price has increased and with production costs⁷.

Second, Indonesia has not implemented a carbon tax. Another enabler is the low cost of energy storage and is a supporter of the carrying capacity of EBT. With the large capacity of the Suralaya PLTU, it is not easy to replace it with RE because land capacity is needed. Third, there is no 'previllage or incentive' for companies that can close the PLTU, getting the first opportunity to replace it with renewable energy. Many investors want this scheme. However, the new RE Development process must be included in the RUPTL document and carried out through competitive bidding.

⁶ BPP (Basic Cost of provision) Suralaya is about ID 1,000 and electricity tariff (non-subsidy) is about IDR 1,300.

⁷ <https://ima-api.org/detail/news/mining/ongkos-tambang-makin-mahal-harga-dmo-batu-bara-diminta-naik>

What are the major factors to consider when choosing/prioritizing retirement of coal power plants?

- Outstanding loans of plants
- **Remaining lifespans of plants**
- Revenue / net profit of plants
- **Impact to the local electric grid (energy security and stability)**
- ...

Ability and speed to provide replacement generating capacity. Every Power Plant Development must be included in the Electricity Supply Business Plan (RUPTL). RUPTL covers the provision of power plants, transmission networks, and distribution of electricity. In the vertically integrated electricity business conditions, the state electricity company (PLN) is not agile / responsive enough to respond to changes in demand. Meanwhile, making changes to the RUPTL is also not easy because the preparation of this document involves many parties. Experience shows that from the planning process to implementation it takes a long time, it is not certain that the new capacity can be installed within a period of 3 years. Thus, to retire the PLTU, a large reserve margin is needed first so that system reliability is maintained. Therefore, it is very possible that in the early stages of the transition there will be an over-investment condition to maintain a stable system. Thus, the more appropriate term is not coal retirement, but coal phasing down.

What is the existing preference and projected trend in coal and renewable energy investment in the country/province?

Currently, the use of biomass with a combination of carbon capture and storage (CCS) is attractive to financing institutions. Furthermore, this model is also supported by the existence of carbon emission reduction certificates that can be sold. Reducing carbon emissions must also meet economic feasibility. Thus, how to make emission reduction efforts an attractive business. This is because carbon emission reduction cannot be carried out sustainably if it is based on voluntary efforts. The construction of solar power plants (PLTS) plus batteries is also increasingly attractive. Currently, the Company has completed a contract for the Saguling PLTS (floating) with a capacity of 110 MW. Other PLTS projects are also being explored in 5 locations with a total capacity of 500 MW. PLN also opens space for renting small-capacity generators, especially for locations outside Java. Most rental contracts are for diesel-fueled power plants, perhaps they also need to be opened for renewable energy-based rentals

Section 3: Economic and Financial Barriers

What are the key economic barriers to early retirement of this coal power plant?

- Decommissioning costs
- **Lost revenue from the plant's operations**
- Need for compensation to shareholders or investors
- Costs of shutting down supply chains
- **Other (please specify)**

Because the company buys coal with the DMO scene, the resulting prices can be lower. With the cost of supply below the tariff, economic feasibility is achieved. Although the condition occurs due to the existence of coal subsidies and the absence of carbon taxes. However, this condition allows

the company to reduce subsidies and energy compensation. Both things are in line with the interests of the government as a shareholder.

What financial risks are most significant for the plant owners if the plant is retired early?

- Loss of investment returns
- Devaluation of plant assets
- Impact on financial contracts or PPAs
- **Other (please specify)**

Although technically Suralaya I – IV is worthy of being stopped, there are still book values that need to be resolved, especially related to the budget for maintenance and operations.

What financing challenges do plant owners face in transitioning from coal to renewable energy?

- Difficulty in securing loans for renewable investments
- Inability to access low-interest or green financing
- Lack of trust from financial institutions in renewable projects
- The profit of renewable energy projects
- **Other (please specify)**

There is no regulatory certainty that companies retiring coal-fired power plants will be given priority to replace them with renewable energy. For example, the challenge of replacing around 1,600 MW of coal-fired power plants with solar PV certainly requires the availability of a large area, meaning it needs to be built in another location; and to do this, incentives and support from the government are needed, for example related to land provision. The relationship between closure costs and new investments has not been seen as a single unit. Replacement projects for retired coal-fired power plants are still viewed normally as separate new projects. Each new investment must be included in the RUPTL and will be tendered. Therefore, whoever wins has the right to build the replacement power plant. This condition is unattractive to investors.

Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?

- Yes
- **No**
- If yes, how effective have these instruments been?

So far, IP project finance has always worked with local and foreign developers. Funding for RE is mostly from foreign banks such as the World Bank, Mybank, and Standard Chartered Bank. This is done with concern for the environment and implementing ESG principles to reduce risk.

What are the barriers to accessing international climate finance or green investment for this plant's transition?

- Complex application processes
- Insufficient knowledge or awareness of available funding
- Risk perception by international investors
- **Other (please specify)**

There is none, even in the past during the Joe Biden administration, it was very difficult to find financing for PLTU, and more use of internal financing. Currently, the issue is more about whether the transition can make electricity prices cheaper, under the conditions of the DMO policy and the absence of a carbon tax.

How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?

- **Government-backed guarantees**
- **Risk-sharing agreements**
- Climate insurance products
- **Other (please specify)**

There is a guarantee from the government to create the same level of playing field between PLTU and RE. The direct and indirect subsidy policy for PLTU makes RE investment unattractive. The government policy that does not adjust the DMO Coal price provides a guarantee of the certainty of the Coal purchase price for PLN, and this makes the risk of Coal purchases almost non-existent. Unlike RE, one of the policies states that RE purchases are set at a maximum of 85% of PLN's Electricity BPP in each region⁸. This means that after the Coal price is subsidized, the government stipulates that RE purchases must be lower than the Electricity generated from Coal. The asymmetric risk between PLTU and RE generators makes this investment unattractive.

Section 4: Incentives for Coal Plant Owners

What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?

- **Tax credits or subsidies for renewable energy projects**
- Performance-based incentives
- Low-interest loans or grants
- **Other (please specify)**

The bias towards fossil-based energy (Coal) is driven more by Running by regulation and not by competition. Thus, policy support between fossil-based energy and RE needs to be more equal.

⁸ <https://iesr.or.id/harga-listrik-energi-terbarukan-tidak-menarik-2/>

How could investors be incentivized to fund the transition of this coal plant to renewable energy?

- **Guaranteed returns from renewable energy investments**
- Reduced risk through government-backed schemes
- Other (please specify)

The government needs to provide guarantees to private parties who retire PLTUs early, to get priority to develop RE.

What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

Carbon market is an opportunity for RE financing, emission reduction project certificates can be sold on the carbon market. However, the carbon market has not shown encouraging development since it was first launched in September 2023⁹.

Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

IP has collaborated with Saudi Arabia (ACWA Power), to build a floating PLTS in the Saguling reservoir with a capacity of 95.3 megawatt peak. The investment for the construction of the Saguling Floating PLTS is 75 million US dollars or around Rp 1.2 trillion. 75 percent of the project funding will come from international loans and the rest from PLN Indonesia Power (IP) and ACWA Power. A joint venture company PT Indo ACWA Tenaga Saguling was also formed with 51 percent ownership of shares by IP and 49 percent by ACWA¹⁰. Similar cooperation was also carried out between IP and ACWA for a floating PLTS with a capacity of 50 MW in Lake Singkarak, Tanah Datar Regency, West Sumatra.

Section 5: Energy Security and Infrastructure

What energy security concerns are associated with retiring this coal plant early?

- Impact on grid stability and reliability
- Availability of renewable energy sources to meet demand
- Capacity for energy storage solutions
- Other (please specify)

- Impact on grid stability and reliability
- Impact on cost reduction

⁹ <https://www.cnbcindonesia.com/market/20250208125458-17-609069/menteri-lh-ungkap-alasan-bursa-karbon-sepi-lakukan-langkah-ini>

¹⁰ <https://native.kontan.co.id/news/solusi-tantangan-transisi-energi-lewat-plts-terapung-saguling>

- Impact on subsidy

How could Indonesia's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?

In the early stages it may be necessary to face the situation of excess supply of renewable energy, and gradually the supply of PLTU can be reduced without disrupting stability and reliability; intermittent conditions of RE require adequate power storage in the form of batteries or other efforts that do not have a major impact on increasing carbon emissions.

What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?

Storage facilities

Section 6: Social and Workforce Considerations

How would local communities be impacted by the early retirement of this coal power plant?

In the case if IP for Suralaya I – IV very minor impact /manageable impact

What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?

Because the retirement of the PLTU is accompanied by an increase in RE-generating capacity, this will not have too much impact on employment opportunities.

Section 7: Policy and Regulatory Barriers

What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?

There is a guarantee that the Company has the right to develop renewable energy as a replacement and of course considering the need for a large location for the development of PLTS, government support is needed in terms of land access.

Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?

Early retirement of PLTU should be included in RUPTL and Companies that carry out early retirement receive allocation for renewable energy development. But unfortunately, currently the early retirement allocation has not been included in RUPTL¹¹.

What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

Many foreign companies in Indonesia are starting to purchase electricity from renewable energy (Renewable Energy Certificate / REC). The green electricity service in 2024 will be enjoyed by 7,354 customers, more than double compared to 2023, which was 3,378 customers¹². This will certainly encourage an increasingly dynamic demand side and provide greater space for clean energy demand. The current challenge is how the rigidity in the supply side can be minimized to respond to increasingly dynamic demand conditions. Likewise, the Carbon Border Adjustment Mechanism (CBAM) policy will be an opportunity to encourage the adoption of RE development.

Section 8: Role of Foreign Investment and International Support (4 Questions)

What role do foreign investments play in the financing of this coal plant's transition to renewable energy?

Foreign investors can collaborate with domestic companies, both state-owned and private companies, to develop RE investments, such as Masdar (UAE), ACWA Power, and others.

What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?

None

How can foreign investors be incentivized to support the early retirement of coal plants in Indonesia?

- By offering guarantees or risk-sharing mechanisms
- **Through policy frameworks that support long-term stability**
- Other (please specify)

What challenges exist in attracting foreign investment for coal-to-renewables transitions in Indonesia?

- Political risk or instability
- **Risk of insufficient return on investment**
- **Regulatory uncertainty**
- Other (please specify)

¹¹ <https://ekonomi.bisnis.com/read/20250213/44/1839293/pln-sebut-pensiun-dini-pltu-belum-masuk-ruptl-2025-2034>

¹² <https://lestari.kompas.com/read/2025/02/01/130000686/serba-serbi-renewable-energy-certificate-pln--kelebihan-bagi-swasta-dan?page=all>

What aspects of foreign examples in their transition experience would you like to learn more about?

- **Policy & regulation**
- **Financial incentives**
- Decommissioning procedures
- Other (please specify)

Appendix 11: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Malaysia – Jimah East Power (JEP)

Section 1: Information about the Plant Owner and Selected Plant

Plant Owner Name: Tenaga Nasional

Plant Owner's fuel mix for power generation (in % of total MWh generated) in the Country and State in 2023

Fuel Mix	Coal %	Gas %	Hydro%	RE % (Solar/ Biomass	Other (please specify) %	Total
Country	41.70%	32.36%	16.19%	8.13%	Hydro – 16.19%	100%

Plant Owner's power generation contribution (power market share) in the Country, and in the State in 2023 (or 2023, if 2024 data not yet available):

	Power market share (%)
Country	51.11%

What is the Plant Owner's transition strategy?

TNB Genco Energy Transition – Sustainability Pathway 2050. The strategy is to reduce the Green House Gas (GHG) emission intensity.

What is the Plant Owner's emission reduction target?

The target is to reduce emission intensity by 35% through wide adoption of sustainable fuel and clean power plants and reduction of coal capacity by -50% in 2035.

TNB Genco to be coal free by 2045 and aspire to achieve Net zero GHG emissions by 2050.

Details on the selected plants

Plant Name	Jimah East Power (JEP)	TNB Janamanjung
Location	Negeri Sembilan	Perak
Type of Plant	Coal-fired	Coal-fired
Installed Capacity (MW)	2000 MW	4080 MW
Combustion Type	Coal-fired	Coal-fired
Commissioning Year	2019	2005, 2015, 2017

Ownership	Private	Private
Annual Power Generation (MWh)	Based on dispatch/ generation plan	Based on dispatch/ generation plan
Expected Lifespan (years remaining)	19 year	5 year,15 years 17 years
Major Financial Stakeholders (Banks, Investors):	TNB Genco: 3B Power Sdn Bhd (70:30)	TNB Genco

(A remark about the local research: please ask the plant owner representative to explain in detail their response to each question, as we would like more qualitative insight.)

Section 2: Overarching Questions:

- Have you considered retiring the coal power plant you own earlier than planned? If yes, what are the long-term risks or factors that make you concerned?
TNB Genco Energy Transition Pathway 2050 supports the government target to reduce carbon emission intensity by 45% against GDP by 2030 and aspire to achieve net zero emission in 2050. One of the levers for TNB Genco to achieve net zero in 2050 is No New Investment and Potential Phase-Down of Coal Capacity
The long-term risks or factors :
 - External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
 - National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
 - Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
 - Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)
- As a plant owner, what are the top 3 biggest challenges in transitioning from coal power generation?
 - Existing regulatory/contractual obligations
 - Internal investment incentives
 - Expected Internal Rate of Return (IRR) on Continued Operations
 - Changing longstanding business practices and mindsets
 - Additional costs due to plant retirement
 - Infrastructural constraints in the power system and grid

- Insufficient technical skills and capabilities
 - Impact on local communities, including plant workers
3. What are the major factors to consider when choosing/prioritizing retirement of coal power plants?
 - Outstanding loans of plants
 - Remaining lifespans of plants
 - Revenue / net profit of plants
 - Impact to the local electric grid (energy security and stability)
 4. What is the existing preference and projected trend in coal and renewable energy investment in the country/state?
 Government target to reduce carbon emission intensity by 45% against GDP by 2030 and aspire to achieve net zero emission in 2050

Section 3: Economic and Financial Barriers

5. What are the key economic barriers to early retirement of this particular coal power plant?
 - Decommissioning costs
 - Lost revenue from the plant's operations
 - Need for compensation to shareholders or investors
 - Costs of shutting down supply chains
6. What financial risks are most significant for the plant owners if the plant is retired early?
 - Loss of investment returns
 - Devaluation of plant assets
 - Impact on financial contracts or PPAs
7. What financing challenges do plant owners face in transitioning from coal to renewable energy?
 - Difficulty in securing loans for renewable investments
 - Inability to access low-interest or green financing
 - Lack of trust from financial institutions in renewable projects
 - The profit of renewable energy projects
 - Other (please specify)
8. Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?
 ETM (Energy Transition Mechanism)

9. What are the barriers to accessing international climate finance or green investment for this plant's transition?
 - Complex application processes
 - Insufficient knowledge or awareness of available funding
 - Risk perception by international investors
10. How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?
 - Government-backed guarantees
 - Risk-sharing agreements
 - Climate insurance products
 - Other (please specify)

Section 4: Incentives for Coal Plant Owners

11. What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?
 - Tax credits or subsidies for renewable energy projects
 - Performance-based incentives
 - Low-interest loans or grants
12. How could investors be incentivized to fund the transition of this coal plant to renewable energy?
 - Guaranteed returns from renewable energy investments
 - Reduced risk through government-backed schemes
13. What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

The established price of Carbon Tax or Emission Trading System (ETS) and exception mechanism for the stated coal plants will also determine the continuity of the plant.
14. Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

Green Sukuk under the Sustainable and Responsible Investment (SRI) Sukuk Framework

Section 5: Energy Security and Infrastructure

15. What energy security concerns are associated with retiring this coal plant early?
 - Impact on grid stability and reliability
 - Availability of renewable energy sources to meet demand
 - Capacity for energy storage solutions

16. How could Malaysia's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?
Grid modernization, accommodating RE power, connecting new power generation projects to the grid, meeting large demand growth, customer service enhancement, and grid resilience.
17. What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?
- Smart Grid technologies
 - Battery Storage technology

Section 6: Social and Workforce Considerations

18. How would local communities be impacted by the early retirement of this coal power plant
- Potential attraction towards investment in renewables, battery storage, or sustainable industries.
 - Potential job reskilling/development and workforce redeployment.
19. What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?
Involving community members in planning for the transition can improve outcomes and build trust

Section 7: Policy and Regulatory Barriers

20. What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?
Incentives for transition, regulatory framework for energy storage, and limited carbon pricing mechanism.
21. Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?
The National Climate Change Policy 2.0 (NCCP 2.0) aims to facilitate the country's transition towards a low-carbon economy and climate-resilient development, as well as operationalizing the Paris Agreement at the domestic level.
Along with the NCCP, the Nationally Determine Contributions (NDC) Roadmap and Action Plan to guide implementation until 2030, together with the Long Term Low Emissions Development Strategies (LT Leds) to achieve its net-zero GHG emissions aspiration by 2050
22. What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

Influential role in shaping the decision ; access to international financing, pressure from global investors, and aligning with global commitments.

Section 8: Role of Foreign Investment and International Support (4 Questions)

23. What role do foreign investments play in the financing of this coal plant's transition to renewable energy?
Foreign investment and international support play role in area where domestic financial capacity may be limited eg debt refinancing or repurposing coal assets mechanism
24. What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?
Green Climate Fund
25. How can foreign investors be incentivized to support the early retirement of coal plants in Malaysia?
 - By offering guarantees or risk-sharing mechanisms
 - Through policy frameworks that support long-term stability
 - Other (please specify)
26. What challenges exist in attracting foreign investment for coal-to-renewables transitions in Malaysia?
 - Political risk or instability
 - Risk of insufficient return on investment
 - Regulatory uncertainty
27. What aspects of foreign examples in their transition experience would you like to learn more about?
 - Policy & regulation
 - Financial incentives
 - Decommissioning procedures

Appendix 12: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Malaysia –Solar Energy Research Institute, Universiti Kebangsaan Malaysia

Section 1: Information about the Plant Owner and Selected Plant

What is the Malaysia's Plant Owner's transition strategy?

Malaysia's coal transition strategy reflects a clear national goal: to reduce coal-fired power generation by 50% by 2035 and to fully retire all coal plants by 2044. Plant owners, particularly Tenaga Nasional Berhad (TNB), are supporting this shift proactively. Strategies include early retirement of coal plants, which may involve renegotiating power purchase agreements or decommissioning facilities ahead of schedule. At the same time, there is increasing investment in alternative energy sources—particularly natural gas and solar.

Existing coal plant infrastructure may be repurposed for renewable energy projects or energy storage. While phasing out coal, efforts are being made to optimize current operations and reduce emissions. Importantly, the transition is being guided by principles of fairness and inclusivity, with initiatives in place to support collaboration and workforce reskilling, ensuring affected workers have opportunities in the growing clean energy sector.

What is the Malaysia's Plant Owner's emission reduction target?

Malaysia has set a national goal to reach net-zero greenhouse gas emissions by 2050. Supporting this ambition, Tenaga Nasional Berhad (TNB), the country's main electricity provider, has laid out a clear emissions reduction strategy. TNB plans to cut its direct (Scope 1) carbon emission intensity by 35% by 2035, using 2020 as the baseline year. The company is also committed to achieving net-zero emissions by 2050. These targets reflect TNB's role in driving Malaysia's low-carbon energy transition and its efforts to align with global climate commitments through cleaner operations and sustainable energy investments.

Section 2: Overarching Questions:

1. Have Malaysia considered retiring the coal power plant earlier than planned? If yes, what are the long-term risks or factors that make Malaysia concerned?

- **External Costs** (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
Yes, Malaysia has considered early coal retirement, but external costs pose challenges. The potential introduction of carbon pricing or tax schemes could significantly increase operational costs. However, the absence of a mature carbon market in Malaysia makes it uncertain how such mechanisms might impact long-term investment and cost recovery.
- **National Policy Changes** (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
Malaysia's commitment to net-zero by 2050 and updates to the National Energy Transition Roadmap have encouraged early coal retirement. However, policy gaps and the lack of firm coal phase-out legislation create uncertainty for plant owners. A clear regulatory framework is needed to guide investments in alternative energy and just transition pathways.
- **Market Risk** (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
Renewables like solar are becoming cheaper and more widely used in Malaysia. Coal is starting to lose its competitive edge, especially as the government supports more green energy projects. But sudden shifts in the market could impact plant owners' revenues, especially those still tied to coal.
- **Sovereign Risk** (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)
Many coal plants in Malaysia are backed by government-linked contracts. If there are delays in tariff payments or sudden changes in government policies, it can affect trust and investment. This makes private companies cautious about retiring coal early unless they see stable support from the government.
- **Other** (please specify)
In areas like Perak and Sabah, coal plants provide jobs and support local economies. Retiring them too early, without proper reskilling or alternative job opportunities, can hurt communities. A fair and just transition needs to include local people, not just focus on climate targets.

2. What are the top 3 biggest challenges in transitioning from coal power generation?

- Internal investment incentives

- Expected Internal Rate of Return (IRR) on Continued Operations
- Changing longstanding business practices and mindsets
- Additional costs due to plant retirement
- Existing regulatory/contractual obligations
- Infrastructural constraints in the power system and grid
- Insufficient technical skills and capacities
- Impact on local communities, including plant workers
- Others...

The top 3 biggest challenges are:

1. Existing regulatory/contractual obligations

Many coal plants in Malaysia operate under long-term contracts, often backed by government-linked entities. Ending these early may involve penalties or complex renegotiations. Plant owners are cautious, as breaking or changing contracts can lead to financial losses and legal complications, slowing down the transition to cleaner energy.

2. Impact on local communities, including plant workers

Coal plants support thousands of jobs, especially in rural areas. Shutting them down early can affect families and local economies. Without a solid plan for retraining workers and creating new jobs, there's resistance to change. People need security and opportunities in the new energy future.

3. Infrastructural constraints in the power system and grid

Malaysia's grid was designed around centralized coal and gas plants. Transitioning to renewables like solar and wind, which are variable and decentralized, requires major upgrades in infrastructure, smart grids, and storage systems. These upgrades are costly and take time to plan and implement effectively.

3. What are the major factors to consider when choosing/prioritizing retirement of coal power plants?

- Outstanding loans of plants
- Remaining lifespans of plants
- Revenue / net profit of plants
- Impact to the local electric grid (energy security and stability)
- ...

When considering the retirement of coal power plants in Malaysia, several key factors must be carefully balanced. First, the remaining lifespan of the plant plays a major role—older, less efficient plants are typically prioritized for retirement as they are costlier to maintain and produce higher emissions. Second, outstanding loans or financial obligations tied to the plant can complicate retirement decisions. If a plant still has significant debt, retiring it early could burden the plant owner or government unless financial restructuring or compensation mechanisms are in place.

Another important factor is the plant's revenue or profitability. If the plant is still generating a good return, owners may hesitate to shut it down without clear financial incentives or alternative income streams. Lastly, energy security and grid stability are critical. Some coal plants play a key role in maintaining a reliable electricity supply, especially in certain regions or during peak demand. Retiring them without first strengthening the grid or replacing capacity with renewables or flexible power sources could lead to supply risks.

In summary, the decision requires balancing financial, operational, and national energy needs while ensuring that early retirement does not disrupt power supply or increase electricity costs for consumers.

4. What is the existing preference and projected trend in coal and renewable energy investment in Malaysia?

Malaysia is actively transitioning from coal to cleaner energy sources. Natural gas is currently the preferred alternative due to its reliability and lower emissions compared to coal. The National Energy Transition Roadmap (NETR) projects that natural gas will comprise 56% of the primary energy supply by 2050, while renewable energy (RE) is expected to reach 22%.

Significant investments are being made to boost RE capacity. Tenaga Nasional Berhad (TNB) plans to increase its renewable energy investments nearly six-fold between 2025 and 2030, allocating about RM90 billion to enhance the national grid and support energy transition initiatives. The government aims to achieve 31% renewable energy capacity by 2025 and 40% by 2035.

To support this shift, Malaysia is implementing projects like solar parks, hybrid hydro- floating solar photovoltaic systems, and green hydrogen hubs . These efforts are part of a broader strategy to phase out coal power plants by 2040 and achieve net-zero emissions by 2050.

In summary, Malaysia's energy investment trend is moving away from coal, with a focus on natural gas as a transitional fuel and a strong push towards expanding renewable energy infrastructure.

Section 3: Economic and Financial Barriers

5. What are the key economic barriers to early retirement of this particular coal power plant?

- Decommissioning costs
- Lost revenue from the plant's operations
- Need for compensation to shareholders or investors
- Costs of shutting down supply chains
- Other (please specify)

Retiring a coal power plant early comes with some tough economic challenges. First, there are decommissioning costs—it's expensive to safely shut down and dismantle the plant. Then, there's the lost revenue since the plant might still be making money. Stopping it means losing that steady income. Plant owners also have to think about the compensation to shareholders and investors who might lose out if the plant shuts down early. On top of that, shutting down supply chains—like coal deliveries and services—could cause disruption and extra costs. And don't forget the need to support workers and local communities affected by the closure, which could involve retraining or creating new jobs. All these financial hurdles make it a tough decision for plant owners to retire coal plants before they've reached the end of their expected lifespan.

6. What financial risks are most significant for the plant owners if the plant is retired early?

- Loss of investment returns
- Devaluation of plant assets
- Impact on financial contracts or PPAs
- Other (please specify)

Retiring a coal power plant early comes with several financial risks. One of the biggest concerns is the loss of investment returns. If the plant is shut down before it reaches the end of its lifespan, owners risk not getting the full return on their investments. There's also the devaluation of plant assets. Once the plant is retired, its value drops, and owners might not be able to sell it or use it for other purposes. Another significant risk is the impact on financial contracts like Power Purchase Agreements (PPAs). These long-term contracts might be disrupted, leading to potential penalties or the need to renegotiate terms, which can result in financial losses. Additionally, there may be other unexpected costs, like paying off debts tied to the plant or compensating stakeholders. All these risks make it financially challenging for owners to decide to retire coal plants early.

7. What financing challenges do plant owners face in transitioning from coal to renewable energy?

- Difficulty in securing loans for renewable investments
- Inability to access low-interest or green financing
- Lack of trust from financial institutions in renewable projects
- The profit of renewable energy projects
- Other (please specify)

Plant owners face several financing challenges when trying to shift from coal to renewable energy. One major issue is the difficulty in getting loans for renewable projects. Banks and lenders may still see coal as more stable and are hesitant to back newer technologies, especially if the plant owner doesn't have a track record in renewables. Also, many owners struggle to access low-interest or green financing, which is often reserved for large or well-established renewable companies. There's sometimes a lack of confidence from financial institutions, especially if the project is in early stages or located in areas with weaker policies or grid support. Another concern is that renewable energy projects may not bring in profits as quickly as coal did, especially during the first few years. On top of that, navigating government incentives and approval processes can be time-consuming and complicated. All of these factors make the transition financially challenging.

8. Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?

- Yes
- No
- If yes, how effective have these instruments been?

Yes, Malaysia offers several financial tools to support coal plant owners in transitioning to cleaner energy. These include green bonds, sustainability-linked bonds, and the Green Technology Financing Scheme (GTFS), which provides interest rate reductions and partial loan guarantees for green projects. However, accessing these funds can be challenging due to strict eligibility criteria and complex application processes. Additionally, the available financing often covers only a portion of the required investment, making it difficult for plant owners to fully fund the transition. While these instruments are a positive step, more streamlined processes and increased financial support are needed to effectively facilitate early coal plant retirement in Malaysia.

9. What are the barriers to accessing international climate finance or green investment for this plant's transition?

- Complex application processes
- Insufficient knowledge or awareness of available funding
- Risk perception by international investors
- Other (please specify)

In Malaysia, there are a few key barriers to accessing international climate finance or green investment when trying to move away from coal. First, the application process is often complex and time-consuming. Plant owners may find it difficult to prepare the required documents or meet the strict criteria set by international funders. Second, there's often a lack of awareness or understanding about what funding is available and how to apply for it.

Many smaller players may not even know such options exist. Third, international investors sometimes see these projects as risky, especially if they think the government policies might change or the financial return isn't clear. There can also be concerns about whether the local team has enough experience in managing large renewable energy projects. All of this makes it tough for plant owners in Malaysia to tap into global green funds, even if they are ready to transition to cleaner energy sources.

10. How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?

- Government-backed guarantees
- Risk-sharing agreements
- Climate insurance products
- Other (please specify)

To help plant owners feel more secure when moving from coal to renewable energy, several steps can reduce financial risk. One helpful option is government-backed guarantees, which assure banks and investors that the project is safe, making it easier to get funding. Risk-sharing agreements can also help, where the government or private partners share some of the financial burden if things don't go as planned. Climate insurance products are another tool—they offer protection if weather or natural events affect the new renewable setup. It's also important to have clear long-term energy policies and stable electricity pricing, so plant owners can plan their investments with confidence. On top of that, offering training or advisory support to guide plant owners through new financing models and project development can reduce uncertainty. Together, these steps make it less risky and more attractive for coal plant owners to invest in cleaner energy alternatives.

Section 4: Incentives for Coal Plant Owners

11. What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?

- Tax credits or subsidies for renewable energy projects
- Performance-based incentives
- Low-interest loans or grants
- Other (please specify)

For Malaysia, several financial incentives could encourage coal plant owners to shift toward renewable energy. Tax credits or subsidies for setting up solar, biomass, or other clean energy projects would reduce the upfront cost and make the transition more appealing. Low-interest loans or government grants would also help, especially since renewable energy projects can take time to start generating profits. Another useful approach would be

performance-based incentives, where owners are rewarded for reaching certain clean energy targets or emission reductions. This helps keep long-term goals in focus. Additionally, offering support for feasibility studies, grid connection upgrades, and worker reskilling programs would make the shift smoother. If plant owners feel supported and see a real financial benefit, they'll be more willing to invest in clean energy. These incentives would show that the government is serious about the energy transition and ready to partner with the private sector to make it work.

12. How could investors be incentivized to fund the transition of this coal plant to renewable energy?

- Guaranteed returns from renewable energy investments
- Reduced risk through government-backed schemes
- Other (please specify)

To attract investors to support the shift from coal to renewable energy in Malaysia, we need to make it financially safe and rewarding for them. One way is to offer guaranteed returns, so investors know they'll earn a steady income from their investment, even if the project takes time to grow. Another helpful step is to provide government-backed schemes or guarantees that reduce their risk—this means if anything goes wrong, like policy changes or market issues, the government helps cover the losses. Investors also look for stable, long-term energy policies, so they can trust the business environment. Offering tax breaks, easier loan access, or co- investment from public funds can also make renewable projects more attractive. When

investors feel that their money is protected and the business is supported by solid policies and incentives, they'll be much more willing to fund the transition from coal to cleaner, greener energy.

13. What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

Carbon markets and carbon pricing can play a big role in helping coal plant owners think twice about continuing with coal. If there's a price to pay for every ton of carbon released, running a coal plant becomes more expensive over time. This makes renewable energy look like a smarter and cheaper option in the long run. If Malaysia strengthens its carbon pricing or joins more carbon credit trading systems, plant owners could even earn money by cutting emissions or switching to cleaner energy. It's a way to turn environmental responsibility into a financial opportunity for plant owners and investors.

14. Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

Yes, some local and international funds could help finance the shift from coal to renewable energy. For example, Malaysia has access to green financing programs through banks like Bank Negara Malaysia and government-backed green tech funds. Internationally, there are climate funds such as the Green Climate Fund and Asian Development Bank's energy transition programs that offer support for clean energy projects. However, many plant owners may

not know how to access these funds or meet the strict requirements. With better guidance and support, these funds could play a big part in making the transition easier and faster.

Section 5: Energy Security and Infrastructure

15. What energy security concerns are associated with retiring this coal plant early?

- Impact on grid stability and reliability
- Availability of renewable energy sources to meet demand
- Capacity for energy storage solutions
- Other (please specify)

Retiring a coal plant early in Malaysia raises real concerns about energy security. One major worry is grid stability—coal plants provide a steady, reliable power supply, and removing them too soon might cause disruptions, especially during peak demand or bad weather. While renewable energy like solar and hydro is growing fast in Malaysia, there are still questions about whether there's enough consistent renewable power available to fully replace coal. On top of that, energy storage systems, like large batteries, are still limited in capacity and not yet widely deployed. Without strong storage solutions, it's harder to balance supply and demand when renewable sources fluctuate. Areas far from urban centers, such as East Malaysia, may face greater challenges in maintaining reliable electricity. So, while transitioning to clean energy is important, it must be carefully planned to avoid energy shortages and ensure Malaysians continue to receive stable, affordable, and secure electricity.

16. How could Malaysia's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?

To prepare for renewable energy after closing a coal plant, Malaysia needs to upgrade its energy infrastructure. This includes improving the national grid to handle power from solar, wind, and hydro sources, which can be unpredictable. We also need more energy storage systems, like batteries, to store extra power when the sun shines or the wind blows. Building smart grids can help balance supply and demand better. In rural or remote areas, decentralized systems like mini solar farms could ensure reliable electricity.

17. What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?

To support the transition from coal to renewable energy, Malaysia needs to make a few key infrastructure improvements. First, upgrading transmission lines is essential so that electricity from renewable sources, like solar or wind, can travel efficiently across the country. Energy storage facilities, such as large batteries, are also important to store extra energy when the supply is high and release it when needed. Additionally, smart grids that can adjust to changes in energy supply and demand will make the system more reliable. These upgrades are vital to ensuring a smooth, stable energy transition as coal plants close

Section 6: Social and Workforce Considerations

18. How would local communities be impacted by the early retirement of this coal power plant?

The early retirement of a coal power plant could impact local communities in a few ways. Job loss is the most immediate concern, as many people work directly at the plant or in related industries. This can affect their livelihoods and create uncertainty. Local businesses that depend on the plant's operations might also feel the pinch. On the positive side, transitioning to renewable energy could bring new job opportunities in the clean energy sector, but workers may need retraining. Communities might also benefit from cleaner air and healthier environments, leading to long-term improvements in quality of life

19. What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?

To reduce the negative social impacts of coal plant closures, a few strategies could be helpful. Reskilling programs for workers can prepare them for new jobs in the renewable energy sector, like solar or wind energy, helping them transition smoothly. Local economic development initiatives, such as supporting small businesses and attracting clean tech investments, can create new job opportunities. Governments can also provide financial support or transition packages to assist workers and communities during the change. Additionally, community engagement is key—getting locals involved in the decision-making process ensures their concerns are heard and addressed.

Section 7: Policy and Regulatory Barriers

20. What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?

To make the transition from coal to renewable energy smoother, Malaysia should address a few key policy and regulatory barriers. First, clear and stable renewable energy policies are crucial to provide long-term certainty for investors and plant owners. Simplifying permitting processes for renewable projects can speed up the transition. Additionally, creating incentives for early retirement of coal plants, such as tax breaks or subsidies, could help offset the costs. The government should also ensure that grid access is available for renewable energy projects and encourage collaborations between the public and private sectors to support this shift.

21. Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?

To accelerate the financial and operational readiness for transitioning to renewables, Malaysia could implement a few supportive policies. Offering tax incentives or grants for renewable energy projects would reduce the financial burden on plant owners. Policies that encourage partnerships between private companies and the government could help share the transition costs. Simplifying regulations around renewable energy projects, such as easier permitting and faster approvals, would speed up the process. Additionally, creating a clear roadmap for phasing out coal and supporting retraining programs for workers would help ensure a smooth transition to cleaner energy sources.

22. What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

In Malaysia, international regulations like climate accords and carbon markets influence the decision to retire coal plants early. Commitments under agreements like the Paris Agreement require Malaysia to reduce its carbon emissions, encouraging the shift away from coal. Carbon pricing also makes coal-fired power more expensive, creating a financial incentive for plant owners to move towards cleaner energy. These international frameworks align with Malaysia's goal to achieve net-zero emissions by 2050, and by complying with them, Malaysia can attract green investments and improve its global environmental standing. These regulations help accelerate the transition to renewables.

Section 8: Role of Foreign Investment and International Support (4 Questions)

23. What role do foreign investments play in the financing of this coal plant's transition to renewable energy?

Foreign investments play a crucial role in financing Malaysia's transition from coal to renewable energy. For example, international companies like Google and Shell have already invested in renewable energy projects in Malaysia, bringing in both capital and advanced technology. These investments help fund such as large-scale solar, making the transition more affordable. Additionally, foreign investors can offer expertise in renewable energy and best practices, helping Malaysia improve its energy infrastructure. Such investments also create jobs and boost economic growth in the renewable sector, aligning with Malaysia's goals for a sustainable energy future.

24. What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?

International climate finance initiatives like the Green Climate Fund (GCF) and the World Bank are crucial for Malaysia's transition from coal to renewable energy. For example, the World Bank has supported Malaysia's solar energy projects, providing both funding and technical expertise. The Green Climate Fund also offers financial assistance for developing countries to mitigate and adapt to climate change, helping Malaysia transition to cleaner energy. These initiatives provide grants and low-interest loans, making renewable energy projects more affordable. By accessing such funds, Malaysia can reduce the financial burden of transitioning while meeting its climate goals.

25. How can foreign investors be incentivized to support the early retirement of coal plants in Malaysia?

- By offering guarantees or risk-sharing mechanisms
- Through policy frameworks that support long-term stability
- Other (please specify)

Foreign investors can be incentivized to support the early retirement of coal plants in Malaysia by offering guarantees or risk-sharing mechanisms. For example, the government could provide financial guarantees to ensure that investments in renewable energy projects are secure, even if market conditions are unstable. Additionally, creating clear and stable policy

frameworks would encourage long-term investments by assuring foreign investors that their capital will be protected and that they will have a predictable return on investment. Policies that offer tax incentives or low-interest loans for renewable projects could also help. A case in point is Tenaga Nasional Berhad's (TNB) collaboration with international partners to develop large-scale solar farms, which attracted foreign investments through clear policy frameworks and risk mitigation. By offering such incentives, Malaysia can attract foreign capital, speeding up the transition to renewable energy and supporting the country's commitment to achieving net-zero emissions by 2050.

26. What challenges exist in attracting foreign investment for coal-to-renewables transitions in Malaysia?

- Political risk or instability
- Risk of insufficient return on investment
- Regulatory uncertainty
- Other (please specify)

Attracting foreign investment for Malaysia's transition from coal to renewables comes with several challenges. One major concern is regulatory uncertainty—investors want clear and consistent policies, but if rules or incentives keep changing, it becomes risky for them to commit long-term funding. Political risks, such as shifts in government priorities or leadership changes, can also shake investor confidence. Another challenge is the perceived lower returns from renewable energy compared to traditional coal plants, especially when upfront costs for solar or wind infrastructure are high. For instance, while Malaysia has attracted some green funding, like the Large-Scale Solar (LSS) program, foreign investors still hesitate without stronger guarantees or long-term policy stability. There's also limited access to risk-mitigation tools such as green insurance or government-backed guarantees. To improve this, Malaysia needs to strengthen its clean energy roadmap, offer investor protections, and communicate a stable long-term vision to assure the global investment community.

27. What aspects of foreign examples in their transition experience would you like to learn more about?

- Policy & regulation
- Financial incentives
- Decommissioning procedures
- Other (please specify)

Malaysia can learn much from other countries that have successfully transitioned away from coal, especially in policy, financial incentives, and decommissioning. For example, Germany's coal phase-out offers a strong model. They created a clear, long-term policy with a timeline and backed it with compensation for plant owners and affected workers. Their "Coal Commission" brought together all stakeholders—government, industry, and communities—to agree on the way

forward. We're also interested in how countries like South Korea use green bonds and transition finance to attract public and private investment into renewables.

Another area is how decommissioning is planned and managed—not just closing the plant, but safely handling the site and making sure workers are reskilled or supported. Learning from these examples can help Malaysia craft its own balanced, fair and financially viable plan for moving from coal to clean energy, especially in places like Port Dickson or Manjung.

Appendix 13: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Malaysia –Institute of Strategic and International Studies (ISIS) Malaysia

Section 1: Information about the Plant Owner and Selected Plant

Not able to answer as these questions refer to coal plant owners

Section 2: Overarching Questions:

1. Have Malaysia considered retiring the coal power plant earlier than planned? If yes, what are the long-term risks or factors that make Malaysia concerned?
 - External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
 - National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
 - Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
 - Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)
 - Other (please specify)
2. What are the top 3 biggest challenges in transitioning from coal power generation?
 - Internal investment incentives
 - Expected Internal Rate of Return (IRR) on Continued Operations
 - Changing longstanding business practices and mindsets
 - Additional costs due to plant retirement
 - Existing regulatory/contractual obligations
 - Infrastructural constraints in the power system and grid
 - Insufficient technical skills and capacities
 - Impact on local communities, including plant workers
 - Others...
 - Replacing the significant share of stable, reliable baseload electricity currently provided by coal
 - Impact on electricity tariffs
3. What are the major factors to consider when choosing/prioritizing retirement of coal power plants?
 - Outstanding loans of plants
 - Remaining lifespans of plants

- Revenue / net profit of plants
 - Impact to the local electric grid (energy security and stability)
4. What is the existing preference and projected trend in coal and renewable energy investment in Malaysia?
- Refer to National Energy Transition Roadmap (NETR)
 - i) 70% RE capacity by 2050
 - ii) No new coal plants and existing coal phase out by 2044

Section 3: Economic and Financial Barriers

Not able to answer most of these question directly as they refer to coal plant owners. Some general points for context:

- Most coal power plants in Malaysia are owned by utilities with a diversified portfolio that includes coal, gas and RE.
 - Key factors to transitioning from coal to RE would require considerations for existing PPA's and replacing the lost electricity generation (and not just the installed capacity).
 - Replacing coal with RE is not a one-to-one switch as coal has much higher energy density, requires significantly less land use and can provide stable baseload compared to the key RE source for Malaysia, which is solar.
5. What are the key economic barriers to early retirement of this particular coal power plant?
- Decommissioning costs
 - Lost revenue from the plant's operations
 - Need for compensation to shareholders or investors
 - Costs of shutting down supply chains
 - Other (please specify)
6. What financial risks are most significant for the plant owners if the plant is retired early?
- Loss of investment returns
 - Devaluation of plant assets
 - Impact on financial contracts or PPAs
 - Other (please specify)
7. What financing challenges do plant owners face in transitioning from coal to renewable energy?
- Difficulty in securing loans for renewable investments
 - Inability to access low-interest or green financing
 - Lack of trust from financial institutions in renewable projects
 - The profit of renewable energy projects
 - Other (please specify)
8. Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?
- Yes

- No
 - If yes, how effective have these instruments been?
9. What are the barriers to accessing international climate finance or green investment for this plant's transition?
- Complex application processes
 - Insufficient knowledge or awareness of available funding
 - Risk perception by international investors
 - Other (please specify)
10. How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?
- Government-backed guarantees
 - Risk-sharing agreements
 - Climate insurance products
 - Other (please specify)

Section 4: Incentives for Coal Plant Owners

11. What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?
- Tax credits or subsidies for renewable energy projects
 - Performance-based incentives
 - Low-interest loans or grants
 - Other (please specify)
12. How could investors be incentivized to fund the transition of this coal plant to renewable energy?
- Guaranteed returns from renewable energy investments
 - Reduced risk through government-backed schemes
 - Other (please specify)
13. What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?
- **Currently none, but will depend on the upcoming carbon pricing framework for Malaysia**
14. Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

Section 5: Energy Security and Infrastructure

15. What energy security concerns are associated with retiring this coal plant early?
- **Impact on grid stability and reliability**
 - **Availability of renewable energy sources to meet demand**

- Capacity for energy storage solutions
 - Other (please specify)
16. How could Malaysia's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?
- Accelerate solutions to manage intermittency and short generation duration of solar such as large scale battery storage and pumped hydro
 - Increase interconnectivity with neighbouring countries via the ASEAN power grid
 - Introduce alternative sources of large-scale, stable, reliable baseload electricity such as nuclear
17. What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?
- Refer answer for #16.

Section 6: Social and Workforce Considerations

18. How would local communities be impacted by the early retirement of this coal power plant?
- Loss of local job opportunities, businesses and infrastructure development
 - Loss of technical and vocational training opportunities at the plant
19. What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?
- Replace jobs at coal plant with alternatives that provide similar levels of both job quantity and job quality to the local population that does not require them to relocate
 - Include upskilling and reskilling to plant workers and the local community that improves their capability to seek new jobs as part of the plant retirement process

Section 7: Policy and Regulatory Barriers

20. What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?
21. Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?
22. What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?
- Domestic commitments to net-zero by 2050 and the desire to attract investment that seek clean energy supplies for business (e.g RE100 companies, etc)
 - The EU Carbon Border Adjustment Mechanism (CBAM) would also incentivise the need for a low-carbon grid

Section 8: Role of Foreign Investment and International Support (4 Questions)

23. What role do foreign investments play in the financing of this coal plant's transition to renewable energy?
- Investment will be required not just to finance the early retirement of the plant but also to finance suitable alternatives to replace the lost generation with cleaner alternatives
24. What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?
25. How can foreign investors be incentivized to support the early retirement of coal plants in Malaysia?
- By offering guarantees or risk-sharing mechanisms
 - Through policy frameworks that support long-term stability
 - Other (please specify)
26. What challenges exist in attracting foreign investment for coal-to-renewables transitions in Malaysia?
- Political risk or instability
 - Risk of insufficient return on investment
 - Regulatory uncertainty
 - Other (please specify)
27. What aspects of foreign examples in their transition experience would you like to learn more about?
- Policy & regulation
 - Financial incentives
 - Decommissioning procedures
 - Other (please specify)
 - Technology transfer to improve grid capacity for more intermittent RE, large scale storage solutions and alternative baseload sources

Appendix 14: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Pakistan – Port Qasim Power Plant (Karachi)

Section 1: Information about the Plant Owner and Selected Plant

Type of Plant:

- Coal-fired **Thermal category of power plant, operating on imported coal**
- Other (please specify)

Installed Capacity (MW): **1320 MW**

Combustion Type: **Pie Type One Boiler**

Commissioning Year: **2017**

Ownership:

- Public
- Private, **100% owned by Chinese**
- Joint (Public-Private)

Annual Power Generation (MWh): **More than 9 Mn hours are supplied to the grid, almost 82-85 % of total generation; the remaining is kept for own use.**

Expected Lifespan (years remaining): **30 years**

Major Financial Stakeholders (Banks, Investors): **The initial funds were borrowed from ICBC. China Huaneng Group is the major stakeholder**

Section 2: Overarching Questions:

Have you considered retiring the coal power plant you own earlier than planned? If yes, what are the long-term risks or factors that make you concerned?

- External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
- National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
- Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
- Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)
- **Other (please specify) (The retirement depends upon the national electricity policies of both China and Pakistan. If a sudden policy comes to switch, we will go through a transition.**

As a plant owner, what are the top 3 biggest challenges in transitioning from coal power generation?

- Internal investment incentives
- Expected Internal Rate of Return (IRR) on Continued Operations
- Changing longstanding business practices and mindsets
- Additional costs due to plant retirement
- **Existing regulatory/contractual obligations**
- **Infrastructural constraints in the power system and grid**
- Insufficient technical skills and capacities
- Impact on local communities, including plant workers
- **Others... No timely payments to power producers**

What are the major factors to consider when choosing/prioritizing retirement of coal power plants?

- Outstanding loans of plants
- **Remaining lifespans of plants**
- Revenue / net profit of plants
- Impact to the local electric grid (energy security and stability)
- ...

What is the existing preference and projected trend in coal and renewable energy investment in the country/province?

You can refer to CPEC to check the recent trends in coal and renewable investments.

Section 3: Economic and Financial Barriers

What are the key economic barriers to early retirement of this particular coal power plant?

- **Decommissioning costs**
- **Lost revenue from the plant's operations**
- Need for compensation to shareholders or investors
- Costs of shutting down supply chains
- Other (please specify)

What financial risks are most significant for the plant owners if the plant is retired early?

- **Loss of investment returns**
- **Devaluation of plant assets**
- Impact on financial contracts or PPAs
- Other (please specify)

What financing challenges do plant owners face in transitioning from coal to renewable energy?

- **Difficulty in securing loans for renewable investments**
- Inability to access low-interest or green financing
- Lack of trust from financial institutions in renewable projects
- The profit of renewable energy projects
- Other (please specify)

Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?

- Yes
- **No**
- If yes, how effective have these instruments been?

What are the barriers to accessing international climate finance or green investment for this plant's transition?

- Complex application processes
- **Insufficient knowledge or awareness of available funding**
- Risk perception by international investors
- Other (please specify)

How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?

- **Government-backed guarantees**
- **Risk-sharing agreements**
- Climate insurance products
- Other (please specify)

Section 4: Incentives for Coal Plant Owners

What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?

- **Tax credits or subsidies for renewable energy projects**
- **Performance-based incentives**
- **Low-interest loans or grants**
- Other (please specify)

How could investors be incentivized to fund the transition of this coal plant to renewable energy?

- **Guaranteed returns from renewable energy investments**
- Reduced risk through government-backed schemes
- Other (please specify)

What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

Only if the

Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

Do not know. But yes, if there is any fund available, we could consider it for transition.

Section 5: Energy Security and Infrastructure

What energy security concerns are associated with retiring this coal plant early?

- Impact on grid stability and reliability
- **Availability of renewable energy sources to meet demand**
- Capacity for energy storage solutions
- Other (please specify)

How could Pakistan's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?

If coal power plants are close. We cannot rely on one source of renewable because renewable sources are not stable. We should develop solar, hydro and wind plants as alternatives.

What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?

Renewable sources are not permanent, so they need better and improved infrastructure. Proper location of the renewable plants is important because the transmission lines are not upgraded, so they cannot sustain/store electricity, and their conversion ability of AC to DC and then to AC is not high.

Section 6: Social and Workforce Considerations

How would local communities be impacted by the early retirement of this coal power plant?

Yes, it would impact society because the technical staff and staff working in the fuel operations department will go unemployed immediately because of the transition. Moreover, the electricity supply would be affected because it is very difficult to supply consistent electricity without any outage through renewable sources.

What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?

Unemployment can be controlled if there is a rotation policy in coal power plants. When the transition time comes, employees will be able to perform diverse tasks and can easily be deployed to other departments. Moreover, renewable energy is cheaper, which gives the plant owner the margin to compensate a great number of employees at low cost. Work-life balance would be a good strategy to address this unemployment issue.

Section 7: Policy and Regulatory Barriers

What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?

Renewable energy infrastructure, an alternate source of RE should be developed

Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?

No, such a policy is not available.

What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

Yes, they can if the emphasis is forced transition.

Section 8: Role of Foreign Investment and International Support (4 Questions)

What role do foreign investments play in the financing of this coal plant's transition to renewable energy?

Coal power plants in Pakistan have already been developed with huge foreign funding. Yes, foreign funding could play a very important role in the transition.

What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?

Transition can be made possible with international institutions such as World Bank

How can foreign investors be incentivized to support the early retirement of coal plants in Pakistan?

- By offering guarantees or risk-sharing mechanisms
- **Through policy frameworks that support long-term stability**
- Other (please specify)

What challenges exist in attracting foreign investment for coal-to-renewables transitions in Pakistan?

- **Political risk or instability**
- **Risk of insufficient return on investment**
- **Regulatory uncertainty**
- Other (please specify)

What aspects of foreign examples in their transition experience would you like to learn more about?

- **Policy & regulation**
- **Financial incentives**
- Decommissioning procedures
- Other (please specify)

Appendix 15: Questionnaire on Barriers and Incentives for Coal Plant Early Retirement in Pakistan – Sahiwal Coal Power Plant (Punjab)

Section 1: Information about the Plant Owner and Selected Plant

Type of Plant:

- Coal-fired **Thermal category of power plant, operating on imported coal**
- Other (please specify)

Installed Capacity (MW): **1320 MW**

Combustion Type: **Pie Type One Boiler**

Commissioning Year: **2017**

Ownership:

- Public
- Private **100% owned by Chinese**
- Joint (Public-Private)

Annual Power Generation (MWh):

Expected Lifespan (years remaining): **2015-1-2045**

Major Financial Stakeholders (Banks, Investors):

Section 2: Overarching Questions:

Have you considered retiring the coal power plant you own earlier than planned? If yes, what are the long-term risks or factors that make you concerned?

- External Costs (Ex: carbon tax, carbon pricing, or other environmental compliance costs)
- National Policy Changes (Ex: evolving climate goals, renewable energy (RE)-flavored national energy plans, or potential coal phase-out policies)
- Market Risk (Ex: increasing RE power generation share, price competition from renewable sources, or declining profitability of coal operations)
- **Sovereign Risk (Ex: government default, unsecured tariff payments, or instability in government-backed agreements)**
- Other (please specify) (The retirement depends upon the national electricity policies of both China and Pakistan. If a sudden policy comes to switch we will go transition.

As a plant owner, what are the top 3 biggest challenges in transitioning from coal power generation?

- Internal investment incentives
- Expected Internal Rate of Return (IRR) on Continued Operations
- Changing longstanding business practices and mindsets
- **Additional costs due to plant retirement**
- **Existing regulatory/contractual obligations**
- **Infrastructural constraints in the power system and grid**
- Insufficient technical skills and capacities
- Impact on local communities, including plant workers
- **Others... However, we haven't considered transitioning yet**

What are the major factors to consider when choosing/prioritizing retirement of coal power plants?

- **Outstanding loans of plants**
- **Remaining lifespans of plants**
- Revenue / net profit of plants
- Impact to the local electric grid (energy security and stability)
- **However, we haven't considered transitioning yet**

What is the existing preference and projected trend in coal and renewable energy investment in the country/province?

Before 2015, Pakistan produced only 0.2% of its total electricity from coal. In contrast, China produced 60-70%, the USA produced 35%, and India produced 44% of their total electricity from coal. The contribution of electricity from coal has increased over the last few years, but currently, no trend is seen in investments in coal plants, and future investments are not expected. The local electricity sector is not booming, and existing facilities are not fully operational. It is recommended to first focus on developing the power industry using affordable resources before transitioning to other resources, such as renewable energy.

Section 3: Economic and Financial Barriers

What are the key economic barriers to early retirement of this particular coal power plant?

- Decommissioning costs
- Lost revenue from the plant's operations
- Need for compensation to shareholders or investors
- Costs of shutting down supply chains
- **Other (please specify) Financial contracts and PPAs**

What financial risks are most significant for the plant owners if the plant is retired early?

- Loss of investment returns
- Devaluation of plant assets
- **Impact on financial contracts or PPAs**
- Other (please specify)

What financing challenges do plant owners face in transitioning from coal to renewable energy?

- **Difficulty in securing loans for renewable investments**
- Inability to access low-interest or green financing
- Lack of trust from financial institutions in renewable projects
- The profit of renewable energy projects
- Other (please specify)

Are there existing financial instruments (e.g., green bonds, climate financing) available to help coal plant owners with early retirement?

- Yes
- **No**
- If yes, how effective have these instruments been?

What are the barriers to accessing international climate finance or green investment for this plant's transition?

- Complex application processes

- Insufficient knowledge or awareness of available funding
- **Risk perception by international investors**
- Other (please specify)

How could financial risk be mitigated for the plant owner in the context of transitioning from coal to renewable energy?

- **Government-backed guarantees**
- Risk-sharing agreements
- Climate insurance products
- Other (please specify)

Section 4: Incentives for Coal Plant Owners

What financial incentives or subsidies would encourage this particular plant to transition from coal to renewable energy?

- Tax credits or subsidies for renewable energy projects
- Performance-based incentives
- **Low-interest loans or grants**
- Other (please specify)

How could investors be incentivized to fund the transition of this coal plant to renewable energy?

- **Guaranteed returns from renewable energy investments**
- Reduced risk through government-backed schemes
- Other (please specify)

What role do carbon markets or carbon pricing play in influencing the financial decision-making for this coal plant?

The impact of carbon markets is very minor.

Are there any local or international investment funds particularly suitable for financing the transition of coal plants to renewable energy?

Do not know. But yes if there is any fund available, we could consider for transition.

Section 5: Energy Security and Infrastructure

What energy security concerns are associated with retiring this coal plant early?

- **Impact on grid stability and reliability**
- Availability of renewable energy sources to meet demand
- Capacity for energy storage solutions
- Other (please specify)

How could Pakistan's energy infrastructure be adapted to accommodate renewable energy from the closure of this coal plant?

First, Pakistan should develop a sustainable power industry utilizing available resources, such as local coal, which is cheaper. Second, utilize that electricity at full capacity, minimizing power outages, to generate revenue and develop robust transmission lines before gradually transitioning from coal to renewable energy sources.

What infrastructure improvements (e.g., transmission lines and storage facilities) are necessary to support the transition from coal to renewable energy for this plant?

There is an urgent need to improve transmission lines, since conductors used have a lifespan of 15-20 years and are never replaced or upgraded. This requires substantial investment, as transmission lines cost at least 50% more than building power plants. Unfortunately, infrastructure development requires significant funding, which is lacking, resulting in at least 70% of total electricity produced being lost.

Section 6: Social and Workforce Considerations

How would local communities be impacted by the early retirement of this coal power plant?

First, at least 2000 workers (supporting 2000 families) will lose their jobs due to the transition of this power plant. Second, the Pakistani power sector relies on a load-based system, where transmission lines operate on a ring-based system that is not fully advanced or updated. Line losses will be significant if this power plant undergoes early retirement due to the underdeveloped infrastructure.

What strategies could be employed to mitigate negative social impacts (e.g., job loss, economic decline in coal-dependent areas)?

First, there should be a mechanism for sufficient funds to immediately compensate the 2000 workers who will lose their jobs. Second, there is an urgent need to develop infrastructure, specifically transmission lines, to prevent power outages in the community.

Section 7: Policy and Regulatory Barriers

What policy or regulatory barriers should be addressed to make the transition from coal to renewable energy smoother for this plant?

The impact of financial contracts should be addressed. There is a misperception that prevails about capacity payments, that they are the biggest barrier to early retirement. That's not the case; capacity payments are not exclusive to coal power plants; renewable plants require them too. Annual maintenance for coal plants, which spans 1-2 months every year, requires plants to halt production. During this period, capacity payments serve as financial support to meet operational expenses like salaries. Similarly, renewable power plants, such as wind plants, don't produce consistent electricity and may not be operational year-round. When they're not generating revenue, they also require capacity payments to cover fixed and operational expenses.

Are there specific policies that could accelerate the financial and operational readiness of this plant to transition to renewables?

No as such policy is available but few action plans are there for renewable energy.

What role do international regulations (e.g., climate accords and carbon markets) play in shaping the decision to retire coal plants early?

No specific regulations are there. USA has recently allowed producing electricity from coal.

Section 8: Role of Foreign Investment and International Support (4 Questions)

What role do foreign investments play in the financing of this coal plant's transition to renewable energy?

It matters definitely but it will come through government.

What international climate finance initiatives (e.g., Green Climate Fund, World Bank) are relevant for this plant's transition?

No relevant policy available for transition.

How can foreign investors be incentivized to support the early retirement of coal plants in Pakistan?

- **By offering guarantees or risk-sharing mechanisms**
- Through policy frameworks that support long-term stability
- Other (please specify)

What challenges exist in attracting foreign investment for coal-to-renewables transitions in Pakistan?

- **Political risk or instability**
- Risk of insufficient return on investment
- Regulatory uncertainty
- Other (please specify)

What aspects of foreign examples in their transition experience would you like to learn more about?

- **Policy & regulation**
- **Financial incentives**
- **Decommissioning procedures**
- Other (please specify)