A Business Case for Decarbonization in Pakistan

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ABSTRACT

Pakistan's business sector faces significant decarbonization challenges, largely driven by its dependence on fossil fuels and energy-intensive industries. As the global economy increasingly shifts towards sustainability, it is imperative for Pakistan to transition to low-carbon practices to maintain international competitiveness and meet its climate commitments. Moreover, the establishment of carbon pricing mechanisms and compliance with international frameworks, such as the EU's Carbon Border Adjustment Mechanism, can drive long-term economic and environmental benefits. However, obstacles such as limited access to financing, outdated infrastructure, and high initial costs for green technologies pose challenges to progress. Addressing these barriers requires a combination of policy incentives, the development of green financial instruments, enhanced public-private collaboration, and capacity-building initiatives to support businesses in the transition to a low-carbon economy. By supporting innovation and providing the necessary financial and regulatory support, Pakistan can create a robust business case for decarbonization that drives both economic growth and environmental sustainability.

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1 INTRODUCTION

In simple words, decarbonization means switching from fossil fuels (coal, natural gas or oil) combustion to the low or zero-carbon footprint or renewable/clean energy sources such as wind, solar, hydroelectric, etc. It involves the measures through which a business entity reduces its carbon footprint to save the climate.

Decarbonization refers to the removal of CO2 emissions from processes and throughout the entire value chain. It is a global climate commitment to reduce the carbon footprint in high-emission sectors of economy, particularly those using outdated technologies or inefficient processes. External factors, such as low GDP development, lack of technological upgrades, and insufficient government schemes and incentives, further hinder industries from adopting energy efficiency and decarbonization interventions.

The study highlights the pressing need for businesses and industrialists to recognize sustainability practices as viable, financially rewarding opportunities for industrial growth. For businesses, the transition to a low-carbon economy involves adapting to regulatory changes, such as carbon pricing mechanisms, emissions reduction targets, and stricter environmental standards. Companies that invest in renewable energy, energy efficiency, and low-carbon technologies often

experience reduced operational costs and gain access to government incentives. These incentives can include (i) tax credits, (ii) grants, and (iii) favourable financing options aimed at accelerating the adoption of green technologies.

Development of innovative green financial products helps meet market demand and generates new revenue streams. In addition, companies that take steps toward decarbonization often see improved reputations with consumers and investors, who are increasingly prioritizing sustainability. For businesses, integrating sustainable practices into financial strategies ensures regulatory compliance, attracts ESG-focused investment through a broad investor appeal, reduces operational costs, and drives innovation, securing a company's financial future and enhancing shareholder trust and value.

Objectives: In this context, the study aims to:

- Assess the strengths and limitations of conventional economic analysis techniques and instruments in the context of building decarbonization and explore their impact on feasibility and scalability.
- Identify the key economic drivers, incentives, and lessons from case studies that influence the success of building decarbonization projects and explore best practices in this domain.
- Evaluate the role of economic instruments, such as carbon pricing, subsidies, and tax incentives, alongside government incentives and market demand, in accelerating decarbonization.

2 AN OVERVIEW OF DECARBONIZATION

According to IRENA's World Energy Transitions Outlook 2023 report, the current climate commitments and plans fall far short of meeting the 1.5°C pathway, with an estimated emissions gap of 16 Gt in 2050. Additionally, the energy-related emissions gap could reach 34 Gt by 2050. Furthermore, if fully implemented, the Nationally Determined Contributions (NDCs), long-term low greenhouse gas emission development strategies (LT-LEDS), and net-zero targets could reduce CO_2 emissions by 6% by 2030 and 56% by 2050 compared to 2022 levels. This highlights the critical need for swift, large-scale action to expedite the energy transition (IRENA, 2023).

Various countries face a "triple E" crisis, i.e. Economy, Energy, and Environment, which complicates efforts to decarbonize. For successful decarbonization, a strong government support is crucial in the form of incentives besides establishing a robust regulatory framework, and creating a solid business and economic case for decarbonization. Such support ensures that industries and businesses can transition without suffering economic setbacks and remain on a sustainable path.

2.1 Global Decarbonization Landscape

The annual rate of decarbonization required to limit global warming to 1.5˚C has risen to 20.4%. No G20 country has achieved a decarbonization rate of more than 11.5% since 2000. Despite a record 14% rise in renewable energy capacity in 2023, surging energy demand led to a 1.5% increase in fossil fuel consumption, putting progress at risk. The global rate of decarbonization was just 1.02% in 2023, the smallest decrease in carbon intensity in more than a decade (PwC, 2024). This slowdown highlights a faltering in efforts to decouple economic growth from carbon emissions. To achieve the Net-Zero target by 2050, economies must undergo rapid decarbonization.

There are two aspects to decarbonization. The first entails reducing the greenhouse gas (GHG) emissions produced by the combustion of fossil fuels. This can be done by preventing emissions while using zero-carbon renewable energy sources such as wind, solar, hydropower, geothermal and biomass, which now make up one-third of global power capacity and electrifying as many sectors as possible. Consequently, decarbonization will also require absorbing carbon from the atmosphere by capturing emissions and enhancing carbon storage in agricultural lands and forests. To achieve decarbonization, all aspects of the economy must change from how energy is generated, and how we produce and deliver goods and services to how lands are managed (Cho, 2022).

2.2 Complexities of Decarbonization in Developing Nations

The path to decarbonization is more challenging for developing countries which face several obstacles in the widespread adoption of low-carbon technologies. As of 2023, according to the World Bank, renewable energy made up only 22.02% of total energy consumption in low- and middle-income countries in 2015, a decrease of around 8 percentage points from 2000 levels (Yan et al., 2023). A major obstacle is the lack of capacity to transition away from fossil fuel dependence. These countries have traditionally been resistant to moving away from fossil fuels, due to lack of developmental infrastructure and viable alternatives to fossil fuels, which slows down the transition to clean energy.

FIGURE 1 Global decarbonization market statistics and opportunities for the corporate sector (Insights, 2024).

This failure to move away from fossil fuels not only damaged economic and environmental progress but also resulted in negative social outcomes such as poor health and a lack of job opportunities that could have been created by the growth of clean energy sector (Yan et al., 2023). For developing countries, decarbonization requires a combination of external support and domestic policy changes. Access to affordable financing for green projects, development of infrastructure, and establishment of a predictable policy environment will be critical in enabling businesses to capitalize on the economic opportunities in the aftermath of decarbonization.

2.3. Decarbonization in the Context of Pakistan

Pakistan faces critical roadblocks in its efforts to decarbonize its economy. Its energy sector is heavily reliant on fossil fuels, with over 60% of electricity generation stemming from oil, coal, and natural gas, contributing significantly to CO2 emissions (Umer et al. 2024). Pakistan's energy mix continues to be skewed toward inefficient, carbon-intensive sources due to inadequate infrastructure and investment in renewable energy. While the government has planned to increase renewable energy to 30% by 2030, the share of renewables remained just 6.8% as of March, 2024 (Pakistan Economic Survey, 2023-24). As per its NDCs 2021 submitted to the United Nations Framework Convention on Climate Change (UNFCCC), Pakistan aims to achieve a 50% reduction in its projected emissions by 2030, with 15% of this reduction to come from domestic resources and 35% contingent upon international grant financing. Key decarbonization strategies include increasing the share of renewable energy to 60% and transitioning 30% of its vehicles to electric by 2030, while also implementing a complete ban on imported coal (Government of Pakistan, 2021).

Given this scenario, there is an undeniable business case for investing in decarbonization. The perceived risks associated with investments in green technologies are compounded by the volatility of energy prices and the lack of stable long-term policies. In comparison to developed nations, Pakistan's industrial base is also more dependent on energy-intensive sectors, making the transition to low-carbon solutions more difficult without significant policy support. With the right incentives and investment, Pakistan could design a comprehensive and well-defined business case for decarbonization, which would not only aim to mitigate the country's environmental and economic vulnerabilities but also improve its global competitiveness, ensuring long-term growth.

3 METHODOLOGY

This study adopts a mixed-method approach to assess the business case for decarbonization. Primary data is drawn from a focus group discussion (FGD)1. The secondary data is sourced from academic research, industry reports, government publications, and relevant news sources. The analysis further integrates insights from industry experts and statistical data from 2023 and 2024 reports on Pakistan's industrial emissions, trade statistics, and global market trends. Furthermore, it also explores decarbonization in the context of the Carbon Border Adjustment Mechanism (CBAM) and identifies potential growth opportunities in green investments, technological innovation, and carbon reduction across key sectors.

1 The FGD titled, *A Business Case for Decarbonization in Pakistan*, was held on December 23, 2024.

4 DISCUSSION AND ANALYSIS

4.1 Conventional Economic Analysis for Decarbonization

Balancing the need for economic growth, energy security as well as environmental sustainability is imperative to Pakistan's transition towards a low-carbon economy. The country faces hindrances when it comes to decarbonization, especially within its energy systems. Pakistan's energy-related CO2 emissions amounted to about 201 MTCO2 in 2022, accounting for approximately 0.59% of global emissions (International Energy Agency, 2022). On a per capita basis, Pakistan's GHG emissions are 1.9 tons per capita, roughly one-third of the global average, one-fifth of Western Europe's average, and one-tenth of the US emissions per capita (Ahmad et al. 2025). This presents a unique opportunity to proactively implement cleaner technologies and strategies to position Pakistan as a leader in decarbonization efforts within South Asia.

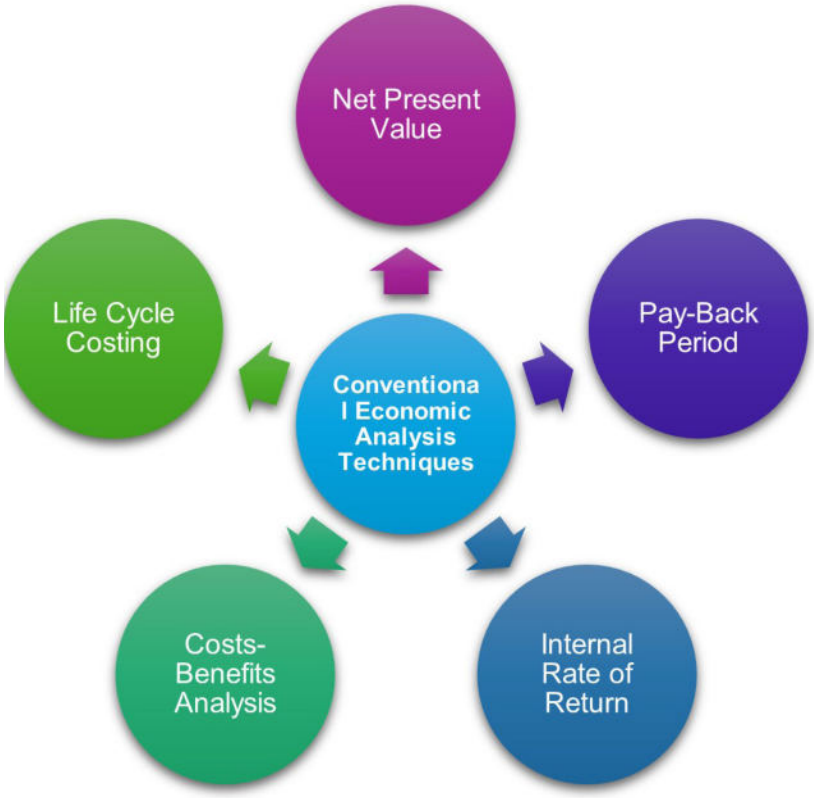
Energy models that account for techno-economic factors are crucial to understanding how Pakistan can decarbonize its energy system. Reliance on fossil fuels makes Pakistan particularly vulnerable to energy price fluctuations. When assessing the economic implications of deep decarbonization (DD) strategies, financial metrics such as Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period, and Life Cycle Costing (LCC) play a critical role.

- **Net Present Value (NPV):** As a tool for assessing the profitability of decarbonization

investments, NPV helps compare projects like solar and wind energy installations to traditional fossil fuel-based energy generation. For instance, through more efficient utilization of its power generation options, Pakistan could save over $1 billion annually on fuel and operating costs (Hogarth, 2020). The capital expenditure is typically high but can see a positive NPV over the long-term due to the lower operating and fuel costs.

- **Internal Rate of Return (IRR):** Renewable energy projects in Pakistan, such as solar and wind, have higher IRRs due to their low operational costs. In Pakistan's case, 67% of the Investment Opportunity Areas (IOAs) have a projected IRR of more than 25%. These include all IOAs from renewable and alternative energy, transportation, infrastructure, and consumer goods sector (United Nations Development Programme 2023).
- **Payback Period:** The current government offers attractive payback periods between 2-4 years for 05–25-kilowatt (kW) net-metered solar PV installations in Pakistan (Isaad & Shah, 2024). This is much shorter than the payback period for traditional fossil fuel-based power plants which can range from 05 to 15 years or more (Carvalho, Hittinger, & Williams, 2021) (Zero Carbon Analytics, 2024).
- **Life Cycle Costing (LCC):** LCC is especially important for projects involving long-term infrastructure such as solar panels or wind turbines. Although initial capital costs can be high, the total cost of ownership over the life of the asset is much lower for renewable energy. Pakistan is already reducing the cost of solar energy, with the levelized cost of electricity (LCOE) for solar power falling below $50/MWh as of 2022, making it competitive with fossil fuel-based generation (Kennedy, 2023)

FIGURE 2 Different techniques for conventional economic analysis.



However, these financial metrics alone are not sufficient for well-rounded decision-making. For example, Cost–Benefit Analysis (CBA) is crucial to fully assess the broader societal and environmental implications of decarbonization projects. This approach highlights the strengths of these financial evaluation methods in guiding decarbonization investments, such as their ability to provide valuable financial insights. However, they also have limitations, such as data challenges

and their inability to fully capture social or environmental impacts, which are crucial in the context of DD strategies (Treut et al. 2021).

4.2 Policy and Economic Tools for Driving Decarbonization in Key Sectors

a) Social Cost of Carbon

The Social Cost of Carbon (SCC) quantifies the economic impact of one ton of carbon dioxide emissions on global well-being. Ranked 5th most vulnerable country to climate change (Igini, 2024) on the Global Climate Risk Index, Pakistan needs to integrate SCC into economic decision-making to help estimate future climate-related costs. With climate change projected to reduce Pakistan's GDP by 18 to 20% by 2050 (Asad, Dahlin, & Barón, 2023), especially impacting agriculture and infrastructure, calculating SCC would enable policymakers to assess the long-term benefits of low-carbon strategies, while incentivizing businesses to internalize environmental costs, speeding up the transition to a decarbonized economy.

b) Carbon Tax, Incentives, and Subsidies

As of 2024, the average carbon tax rate among the 23 European countries was €49.23/tCO2e (Mengden, 2024) while in the US and Canada, it was $48/tCO2e (Oğuz, 2024) and China's carbon price hovered around $12.5/tCO2e (Tiseo, 2024). For Pakistan, implementing a carbon tax could propel industries, particularly in sectors such as energy, transport, and manufacturing, to adopt cleaner technologies and practices. According to the World Bank, carbon-tax scenarios show that a $20 carbon tax can reduce emissions in Pakistan by 36% by 2050 (Burns, Jooste, & Schwerhof, 2021). Careful consideration must be given to the potential economic impact of a carbon tax on vulnerable populations, particularly low-income households, necessitating targeted support measures.

In addition to the carbon tax, Pakistan could implement complementary incentives and subsidies to support the transition. The prices of PVs have dropped by around 60% over the past decade – being sold at PKR 90 /watt in 2010 (Omer, 2020), compared to 2024 when the prices touched as low as PKR 38 /watt (Mufti, 2024). Tax incentives for businesses investing in energy efficiency, clean energy infrastructure, and green technology innovation could stimulate private-sector involvement in decarbonization efforts.

c) Energy Performance Standards

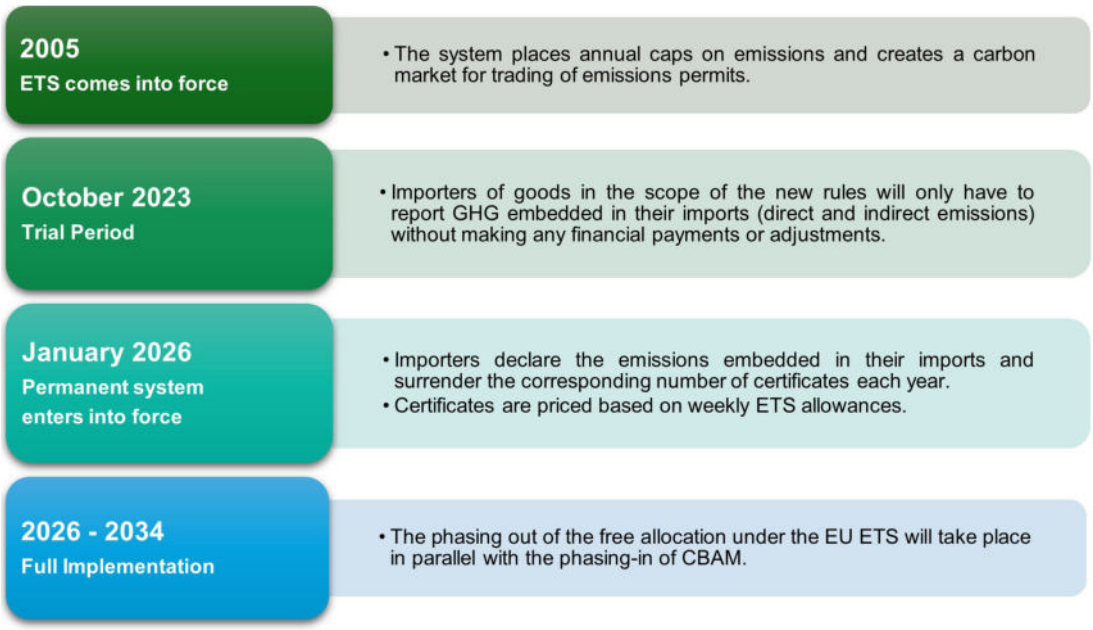
Energy Performance Standards (EPS) are regulations designed to improve the energy efficiency of buildings, appliances, and industrial processes. As of 2024, Pakistan's electricity demand was 68,559 gigawatt hours (GWh) for the fiscal year (FY) July–March (Pakistan Economic Survey, 2023-24). The National Energy Efficiency and Conservation Authority (NEECA) oversees energy performance standards for industries, setting Minimum Energy Performance Standards (MEPS) for various industrial appliances and equipment. This includes a target to ban motors below IE2 standards by 2027, promote energy audits, and implement energy management systems (EnMS) for designated industrial consumers. The government aims to save 2.3 MTOE of energy and reduce emissions by 8.97 MTCO2 by 2030. Additional measures include retrofitting or replacing inefficient industrial boilers and furnaces by 2026, along with mandatory energy audits and five-year energy-saving plans for industrial consumers in addition to the deployment of energy managers and EnMS across the sector by 2026 (National Energy Efficiency & Conseration Authority [NEECA] 2023).

d) Carbon Border Adjustment Mechanism (CBAM)

By imposing a carbon price on imports, European Union's Carbon Border Adjustment Mechanism (EU's CBAM) ensures that domestic industries are not disadvantaged by global competition from countries with less stringent climate policies. CBAM will be fully implemented starting in 2026, with the current transitional phase running from 2023 to 2025 (European Commission, 2025). The sectors covered by CBAM include cement, electricity, fertilizers, iron and steel, and aluminum hydrogen, and some precursors and downstream products made from cement, iron and steel, and aluminum. For Pakistan, which is an emerging market with significant export sectors such as textiles, cement, and steel, the implementation of a CBAM could offer both challenges and opportunities.

On the one hand, the introduction of CBAM can impact Pakistan's export competitiveness if Pakistan does not adopt comparable carbon pricing or mitigation policies, and on the other, Pakistan can strengthen its carbon reduction measures by aligning with international climate commitments and improving its access to low-carbon markets.

FIGURE 3 Implementation Timeline of EU's CBAM.



4.3 Impact of Economic Models and Policy Frameworks

For building the business case for decarbonization, two main approaches can be considered: the "stick" approach and the "carrot" approach. The "stick" approach refers to external pressures, such as the EU's CBAM, and domestic challenges within the energy sector. Pakistan's reliance on imported energy sources contributes to rising electricity costs, directly impacting industrial operations. The CBAM, which imposes taxes on the carbon content of imports, could significantly affect Pakistan's textile exports. Turkey's experience with CBAM reveals the potential risks, with an estimated 9% loss in cement exports and 10% in iron and steel exports to the EU. Similarly, Pakistan's textile sector, already grappling with high input costs, could face additional strain under CBAM due to its National Grid being 1.4 times more carbon-intensive than the EU's. This situation would make Pakistan's textile exports less competitive, as industries dependent on the national grid would incur further costs under the CBAM.

The "carrot" approach, on the contrary, focuses on incentives, such as participation in carbon markets. Under the Paris Agreement, specifically Article 6.2, Pakistan could benefit from internationally transferred mitigation outcomes (ITMOs) by exceeding its Nationally Determined Contributions (NDCs). This would enable Pakistan to trade surplus NDCs with other nations, particularly those in the Middle East, which are struggling to meet their targets. Furthermore, Pakistan has the potential to participate in carbon credit trading, an avenue that has proven successful, as shown by the Delta Blue carbon project, which received competitive prices in carbon markets. However, establishing a fair and effective carbon market is a critical challenge that still needs to be addressed.

5 LESSONS LEARNED FROM CASE STUDIES

By launching the European Green Deal in 2019, the European Union set an ambitious goal to achieve climate neutrality by 2050. This includes intermediate "Fit for 55" targets aimed at reducing GHG emissions by at least 55% by 2030, compared to 1990 levels. Similarly, in the United States, the Inflation Reduction Act (IRA) of 2022 represents the largest climate investment in the US history, committing nearly $370 billion in climate-related spending over the next decade. The IRA aims to reduce emissions by 40% by 2030, relative to 2005 levels. Additionally, the Infrastructure Investment and Jobs Act by the US allocates substantial funding to modernize the energy grid, expand electric vehicle infrastructure, and improve energy efficiency across various sectors (Diaz et al. 2024). Global case studies offer valuable lessons on how decarbonization can serve as a catalyst for both business growth and the fulfillment of environmental targets. These examples highlight the critical role played by government policies, market-driven innovations, and technological advancements in facilitating the transition to a low-carbon economy.

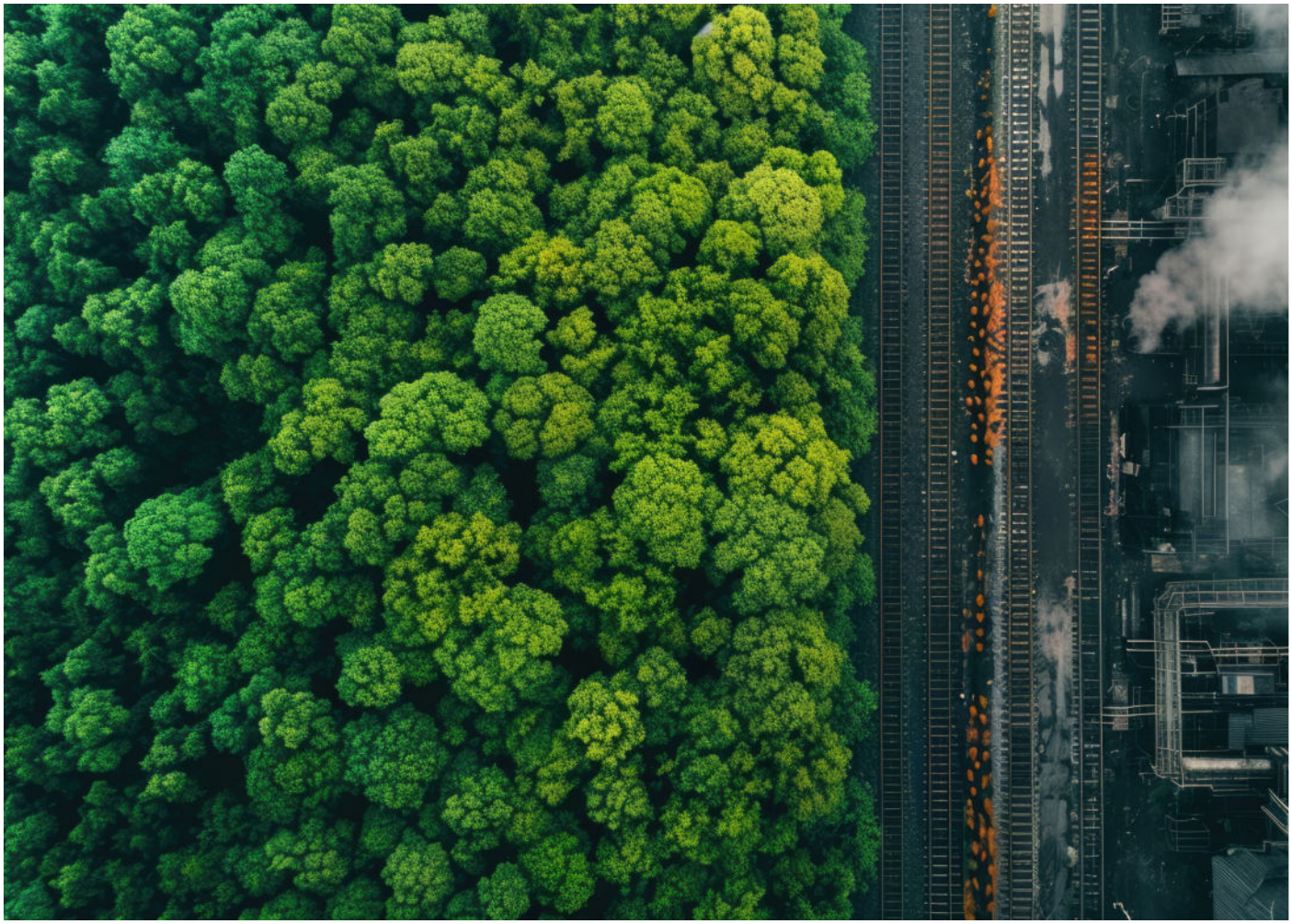


Table 1 shows the countries, technologies, sectors involved, and the key policies or regulations related to decarbonization efforts.

Country	Technology	Sector	Policy/Regulation
Denmark	Offshore wind, Biomethane, District heating, Carbon capture and storage (CCS)	Electricity, District Heating	Climate Act of 2020 ensuring annual policy actions and funding for emissions reductions; Commitment to halting fossil fuel production by 2050 (International Energy Agency [IEA] 2023) (European Commission 2024).
Germany	Hydrogen technologies, Electric mobility	Industrial transformation, Bioeconomy, Forestry, Finance	€200 billion funds to support industrial transformation (2022-2026) (Reuters, 2022).
United Kingdom	Renewables, Natural gas	Power sector	Significant decrease in coal use, replaced by natural gas and renewables, Reduced coal share (39% in 2012 to 2% in 2020) (World Resources Institute, 2024).
Chile	Wind, Solar energy	Power sector	Phase-out of 28 coal-fired power plants by 2040, 31% of coal plants to retire by 2024, Achieving carbon neutrality by 2050 (Baranao & Llamazales, 2024).

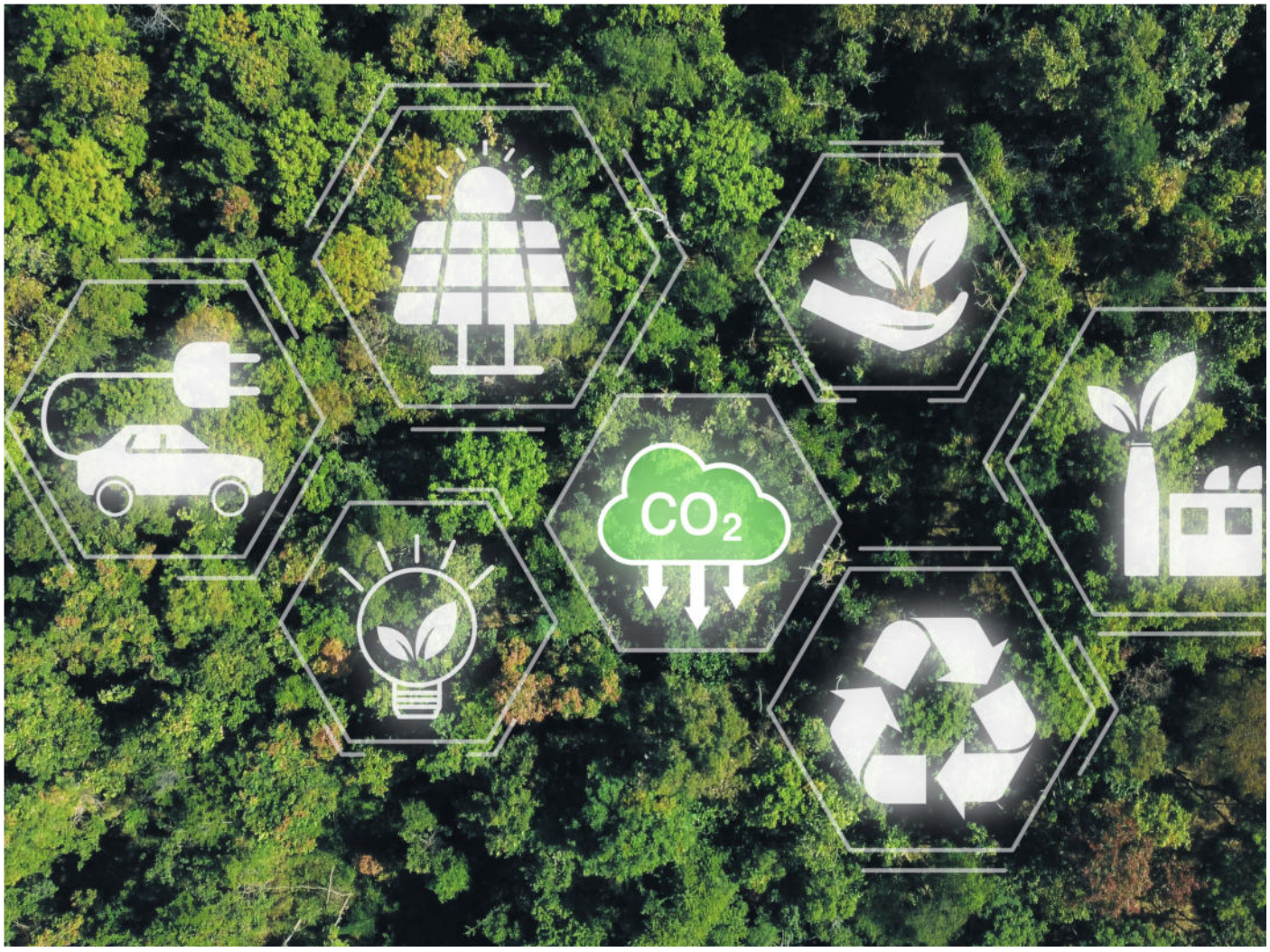
6 CHALLENGES TO PAKISTAN'S ENERGY SECTOR

- Pakistan's energy sector is deeply dependent on fossil fuels, with more than 60% of its electricity generation coming from oil, coal, and natural gas. This reliance contributes significantly to carbon emissions and impedes efforts to transition to cleaner energy sources. Despite the government's goal as per NDCs 2021, to increase renewable energy to 30% by 2030, renewable energy accounted for just 6.8% of Pakistan's energy mix as of early 2024. The country faces a gap in infrastructure development and investment in renewable energy technologies, resulting in slow progress towards meeting renewable energy targets. In addition, the energy sector is confronted with the following challenges.
- Pakistan's economic slowdown, including a contraction of 0.6% in FY23, has strained the country's financial resources. With multiple challenges, such as political instability, rising commodity prices, and global financial tightening, the country faces difficulties in securing the funding needed to support decarbonization efforts.
- Pakistan's climate policy and governance structures remain underdeveloped. Its position in the Climate Change Performance Index (CCPI) reflects the limited commitment to climate

action. This lack of strong, effective policies hinders the implementation of sustainable, low-carbon solutions on a scale.

- Energy inefficiencies in critical sectors such as transportation and industry pose more challenges in the way of decarbonization. Thus, the outdated and inefficient infrastructure needs modernization to reduce energy consumption and improve overall efficiency.
- Large industries, despite their efficiency, often rely on smaller, less-resourced entities within their supply chains, which struggle to meet compliance standards. This poses risks such as penalties, market exclusion, and reputational damage. In Pakistan, Small and Medium Enterprises (SMEs) and the informal sector face additional challenges due to limited financial resources, technology, and expertise to comply with CBAM and global regulations. The fragmented nature of supply chain further complicates efforts to ensure consistent compliance.

7 POLICY RECOMMENDATIONS



- To reduce reliance on fossil fuels, Pakistan must expand its renewable energy sector by attracting investment in solar, wind, and hydropower. Strengthening of policy incentives and improvement in investment infrastructure could help achieve the target of 30% renewable energy by 2030 and reduce dependence on carbon-intensive sources.
- Advancements in energy storage, smart grids, and energy-efficient technologies can help Pakistan in enhancing its energy infrastructure. To align with CBAM and decarbonization goals, Pakistan must reform its electricity tariffs in a way that supports industrial demand for a cleaner grid, ensuring that tariffs are competitive, particularly in relation to CBAM fees, to maintain export competitiveness.
- The government should establish a domestic carbon pricing mechanism tailored to Pakistan's industrial context, gradually encouraging industries to adopt low-carbon technologies. Financial incentives, such as tax rebates or grants for carbon reduction initiatives and energy-efficient technologies, will further support decarbonization. A successful example of this approach is Canada's carbon pricing system, which has led to a 5%-15% reduction in emissions in British Columbia.
- Pakistan should implement a standardized carbon accounting system for businesses, tracking emissions from raw materials to finished goods. Partnerships with global carbon

accounting firms, such as SGS2, will ensure that the system is scalable and aligned with CBAM requirements. Early adoption of such a framework will help industries prepare for CBAM compliance by 2030, reducing the risk of non-compliance shocks.

- The government should implement energy-efficient technologies and practices in transportation, manufacturing, and other high-emission sectors. By encouraging collaboration between the government, private sector, and international partners, the country can facilitate technology transfer and accelerate its decarbonization measures.
- Sustainability reporting must be introduced as mandatory for industries and businesses by the Securities and Exchange Commission of Pakistan (SECP). A standardized reporting framework will improve data transparency, allowing better tracking and management of emissions reduction efforts.

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