**Implementing the UNFCCC-recommended Carbon Pricing Mechanisms (Emissions Trading and Carbon Taxes) for climate mitigation in Pakistan’s Energy sector; An analysis of environmental and economic implications for Pakistan**

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# Chapter-1

# INTRODUCTION TO CARBON PRICING AND EMISSIONS PROFILE OF PAKISTAN’S ENERGY SECTOR

## 1.1 Introduction

For the past two decades, Pakistan has been ranked among the top ten most vulnerable countries on the Climate Risk Index of German Watch, with approximately 10,000 causalities due to climate related disasters from 173 extreme weather events. (Siddique, july 2022) In 2022, Pakistan faced severe droughts and floods that caused extensive damage to assets, lives, and livelihoods. It started with an unprecedented heatwave, previously considered a rare occurrence happening once in a thousand years, with temperatures soaring continuously above 45°C. Subsequently, the country experienced unprecedented monsoon rains, which were the heaviest and most concentrated ever recorded. The southern regions of Pakistan were particularly affected, with hundreds of lives lost, millions displaced, and approximately 2 million houses damaged or destroyed. (Unicef, oct 2022) According to the recently published Post-Disaster Needs Assessment (PDNA) of the 2022 floods, the total estimated damage exceeds US$14.9 billion, with total economic losses of approximately US$15.2 billion, which has dealt a severe blow to the country’s economic growth. The estimated cost for rehabilitation and resilient reconstruction is at least US$16.3billion, not including additional investments required to support Pakistan’s adaptation to climate change and enhance its resilience to future climate shocks. (PDNA, oct 2022)

Pakistan is relatively a small contributor to the global GHG emissions which is roughly 1 percent of the entire planet but still suffers from this transboundary climate crisis being ranked among the top 10 vulnerable countries. In 2018 Pakistan’s total GHG emissions were estimated to be roughly at about 499 million metric tons of carbon dioxide equivalent (MtCO2e) with energy sector being the biggest source of GHG emissions in Pakistan with 218.9 MT CO2 eq. in 2018 making it 46% of the total emissions. (NDC, 2021) Agriculture sector is the second biggest emitter standing at about 198.59 MT CO2 eq. in 2018.Pakistan’s updated National Climate Action Policy includes Pakistan’s unconditional commitment to reduce the overall emissions by 15 percent by 2030 as well as a conditional commitment of further 35 percent emission reduction subject to the availability of climate finance. (NCCP, oct 2021) To achieve this target there are multiple tools in climate action toolbox that maybe Renewable energy sources like wind or solar, green energy, carbon capture and storage technology, blue and green hydrogen as fuel, electrification, carbon pricing and few others.

In regards to a dual challenge of Pakistan including both Climate and economic crisis, Carbon pricing is the most relevant tool of climate action for policy consideration. Carbon pricing which consists of Carbon tax or Green tax and emissions trading is simply the concept of putting a price on a single unit of GHG emission through which the environmental and economic cost of an externality (GHG emissions) can be internalized in a way that corresponds as the concept of “the polluter pays”. Carbon tax or Green tax can be levied by a government on the distribution, sale or use of fossil fuel which causes GHG emissions which encourages businesses and individual to switch to less carbon containing production and consumption. While on the other hand emissions trading works under a cap-and-trade system in which the total allowable emissions in a country are set in advanced by an Emission Trading System (ETS) and permits are created for the allowable emissions which can either be allocated freely or auctioned to companies. The companies can trade these permits using the ETS between one another introducing a market for pollution. (LSE, 2019)

Carbon tax establishes a direct price per unit ton of CO2 emissions which means that the emitter has to pay for their emissions and therefore have to cut down the emissions. If applied on the sector with the largest mitigation potential as in the case of energy sector of Pakistan, carbon tax will lower the GHG emissions as well as raise revenue which can then be used as climate finance. Early carbon taxes were first introduced in the Nordic countries with Finland adopting such tax in 1991, and so far 46 countries have adopted carbon tax while some including Pakistan are considering carbon tax. (Simon Black, july 2022) Pakistan’s National Climate Action Policy mentions Carbon tax in the policy measure regarding the emissions of energy sector with the following words “Consider introducing carbon tax on the use of environmentally detrimental energy generation from fossil fuel” (NCCP, oct 2021) Setting the tax rate depends on the policy goals of the countries. Different countries have adopted different tax rates and have adopted any one of the four approaches of setting a carbon tax rate; the social cost of carbon (SCC) approach which matches the carbon tax rate to estimates of the social costs of GHG emissions, the abatement target approach which involves specific carbon tax rates that is consistent with the country’s emissions reduction objectives, the revenue target approach which generates a particular amount of revenue that can be further invested in country’s mitigation efforts, and the benchmarking approach which links the country’s tax rate to another particular country like a neighboring country or country with similar emission profile. (PMR, 2018) Some examples of carbon tax rates include; Japan 2.36 USD$ per Ton of CO2 equivalent emissions (2.36$/tCO2e), Norway 87.61 $/tCO2e, Latvia 16.5 $/tCO2e, Uraguay 137.30 $/tCO2e. (WB, 2023)

Emissions trading works under a trading system known as Emission trading system (ETS) also known as Cap-and-Trade system set by a regulatory authority which sets a limit of GHG emission by issuing an allowance to the participants involved in the system. Each allowance corresponds to one unit (1ton) of GHG emission and the participants are required to surrender one allowance for every ton of emission they produce. (PMR I. , 2016) The companies in the ETS have the permission to trade the allowance or permits amongst each other, so they can choose to either lower their emission according to the available allowance they have or they can buy allowance units from other participating companies if they are unable to lower their emissions. If the regulator allows, the companies may also be eligible to use and invest in multiple domestic or international offset allowances like creating forests which absorbs carbon from the atmosphere and each ton CO2 absorbed will equate to one allowance units. For example the total carbon stock in the Sustainable Forest Management (SFM) Project in the area of Siran Forest Division, Mansehra was estimated at 1,362,927 tons (PFI, 2019) and so this particular offset will generate 1.36 allowance units.

Regulators can choose one the two approaches of to allocate allowance units to the participating companies; Auctioning the bidding, in which allowance units are allocated through public bidding hence creating a revenue for the government, and Free Allocation in which the allowance units are given to the participating companies hence limiting the “Carbon leakage” where companies relocate to other jurisdictions in order to evade the carbon pricing instruments and therefore emission relocate rather than get reduced. (EU-ETS, 2021) The price of the carbon emission will depend on the supply and demand of the emission units. Different countries have different prices in the ETS markets For example China National ETS price is 9.20$ per one unit allowance of carbon or equivalent GHG gas emission (9.20 $/tC02e), Germany ETS 33.16 $/tCO2e, New Zealand ETS (52.62$/tCO2e). (WB, 2023)

There is consensus among different international organizations and economists regarding the potential of carbon pricing (carbon tax and emission trading) in addressing the reduction of GHG emissions as well as delivering economic benefits. Leaders of different organizations and economist have given their remarks in this regard. According to Kim Yong Kim, President World Bank Group (2012-2019); “Now, many leaders in industry and government are looking to carbon pricing tools as cost-effective mechanisms for creating incentives for climate action. They see the triple dividend of carbon pricing: its contributions to the health of the environment and the public; the revenue it generates; and the innovation and critical investments in clean and low-emission technologies that it can drive.” (CPLC, 2018) The Managing Director of IMF Christine Lagarde argues that putting a price on emission is the way forward in combating the climate crisis. She explains her position regarding climate crisis as “Climate change casts a growing shadow over our well-being and especially the well-being of our children,” […] “The best way to address the problem would be to put a price on carbon, such as by taxing carbon emissions.” (Bloomberg, 2018) 2014 Nobel Laureate in Economic Sciences, Jean Tirole argues for carbon pricing in such words “Putting a price on carbon is the only effective way to curb emissions to combat climate change”. (Busch, 2014) Joseph Stiglitz and Nicholas Stern, Nobel Laureate economists and Co-Chairs of High Level Commission on Carbon Prices, emphasize that carbon pricing is an effective way towards curbing climate crisis and elaborate that “The world’s transition to a low-carbon and climate-resilient economy is the story of growth for this century. Our report builds on the growing understanding of the opportunities for carbon pricing, together with other policies, to drive the sustainable growth and poverty reduction which can deliver on the Paris Agreement and the Sustainable Development Goals.” (Stern., 2017) Paul Romer 2018 Nobel Laureates in Economic Sciences argues that “All we need to do is create some incentives that get people going in that direction, and that we don’t know exactly what solution will come out of it — but we’ll make big progress. The policy is very simple. If you just commit to a tax on the usage of fuels that directly or indirectly release greenhouse gases, and then you make that tax increase steadily in the future … people will see that there’s a big profit to be made from figuring out ways to supply energy where they can do it without incurring the tax.” (CBC, 28 Oct 2018)And as per William Nordhaus 2018 Nobel Laureates in Economic Sciences ;“Economic theory suggests that the best remedy for such externalities is a pollution charge – a charge on carbon emissions, or what is now called a carbon tax. A carbon tax raises the price of carbon emissions to reflect its social costs. It provides powerful incentives to reduce emissions and, as my fellow laureate Paul Romer has shown, to develop new low-carbon technologies.” (Nordhaus, Nobel Prize Lecture, “Climate change: The Ultimate Challenge for Economics”, 2018)

The energy sector in Pakistan is the largest contributor to GHG emissions in Pakistan, with its share about to increase from 46% in 2015 to 56% in 2030. Among energy sector 27% emissions are from energy industries (essentially on power generation), 22% from transport, 20% from energy consumption in manufacturing industries and construction, 23% from “other” sectors and 7% from fugitive emissions. (NDC, 2021) Among the energy sector the main emitters are: 47 power generation units in operation with an emissions volume estimated at 60.4 MtCO2e per year ; 28 cement manufacturing units in operation, 6 under construction and 1 planned the current emissions of which are estimated at 38.2 MtCO2e which can go up to 47.5 MtCO2e ; 10 steel mills in different stages of operation, corresponding to 2.5 MtCO2e; 11 fertilizer production facilities in operation, estimated to generate 6.8 MtCO2e; 8 refineries in operation, with estimated emissions of 5.4 MtCO2e per year and a total of 8.3 MtCO2e if those in the development pipeline enter into operation; 5 glass production facilities, estimated to generate 0.46 MtCO2e; 5 paper and pulp facilities, corresponding to 0.2 MtCO2e (Pak-INDC, 2016)

Carbon tax and Emissions Trading have both the environmental and economic benefits for Pakistan even if only the energy sector gets covered under Carbon tax or ETS. If we take the example of Ireland in the context of Carbon Tax and how it can be useful. Ireland has annual GHG emission of just 68 MtCO2e yet they have implemented a carbon tax since 2010 and the Ireland carbon tax applies to CO2 emissions from all sectors with some exemptions for the power, industry, transport and aviation. Data available on World Bank Carbon Pricing informs that according to the Custom and Tax department of Ireland the tax covers all fossil fuels for example the carbon tax for transport fuels is EUR41/tCO2e (US$45/tCO2e) while other fossil fuels it is EUR34/tCO2e (US$37/tCO2e) and the revenue generated so far is US$542 million while covering only 40% of the Ireland’s GHG emissions (WB, 2023) Now comparing this with Pakistan, the potential for carbon tax in addressing the environmental as well as economic problems of the country is huge when even the single sub sector of Energy sector i.e power generation units has emissions (60.4 MtCO2e) just a little shy from the Ireland whole country’s emissions (68 MtCO2e).

## 1.2 Emissions profile of Pakistan Energy Sector

In recent times, Pakistan has witnessed a significant upsurge in its greenhouse gas emissions, excluding those related to forestry, with a growth rate of 8.5% between 2012 and 2017. The country's emissions (excluding land use) have exhibited a notable 140% escalation from 1990 to 2017. (Chaudhry, 2017) This increase is observable across all sectors, with the energy and agriculture domains witnessing the most substantial absolute rises, while the industrial processes sector has experienced the most notable relative expansion. The country's Nationally Determined Contribution (NDC) outlines a projection of emissions growth by nearly 300% by 2030 compared to 2015 levels. However, the NDC's reduction target of 20%, relative to the projected 300% increase from 2015, by 2030 falls short of achieving compatibility with the 1.5°C target. (NDC, 2021)To align with this goal, emissions should reach 244 MtCO2e by 2030, a considerably lower figure than the lower limit of Pakistan's emissions range, which stands at 1,259 MtCO2e. Main emitting sectors include; Energy sector with the highest among all at 218.9 MT CO2 eq. in 2018, Transportation which is a major energy demanding sector having GHG emissions of 51.3 MT CO2 eq. in 2018, Agriculture sector being as the second highest emitting sector with 198.59 MT CO2 eq. in 2018, Industrial Processes Third largest emitting sector which releases 25.76 MT CO2 eq. in 2018, other (LULUCF) Fourth GHG emitting sector calculated to be 24.86 MT CO2 eq. in 2018, Waste Ranked lowest emitting sector in Pakistan that contributes 21.72 MT CO2 eq. to total GHG emissions in 2018. Methane is the major component with a share of 19.2 MT CO2 eq. (NDC, 2021)

Around 60% of Pakistan's energy composition comprises fossil fuels, encompassing power generation, heating, and transportation fuels. The proportions of fossil fuels and zero-carbon technologies in the country's energy blend remained relatively constant throughout the decade leading up to 2019. (Iea.org, 2020) However, the carbon intensity has grown by 15% during the same period, reflecting an expansion in the nation's overall energy supply. Figure 2.3 depicts the fuel distribution encompassing all energy provisions, not only for electricity generation, heating, and cooking, but also for transportation fuels. Fossil fuels, namely oil, coal, and gas, continue to account for 60% of Pakistan's energy mixture. Although the proportion of renewables (primarily hydro) and nuclear sources in the energy amalgam has experienced a slight increase since 2015, the share of coal more than doubled between 2015 and 2019. (trade.gov, 2022)

The primary factor behind the total greenhouse gas (GHG) emissions is the release of carbon dioxide (CO2) resulting from the combustion of fuels. Over the past ten years, Pakistan has experienced a period of relatively steady emissions, but since 2015, CO2 emissions linked to energy consumption have shown an upward trend. (Dawar Butt, 2021) This surge in energy-related CO2 emissions has positioned it as the most significant GHG source in the country, reaching 218.9 million metric tons of CO2 equivalent in 2018. (enerdata.net, 2021) Within the energy sector, the industrial segment takes the lead with a contribution of 32%, followed closely by transport at 28%, and electricity generation at 27%. (NDC, 2021)

## CHAPTER-2

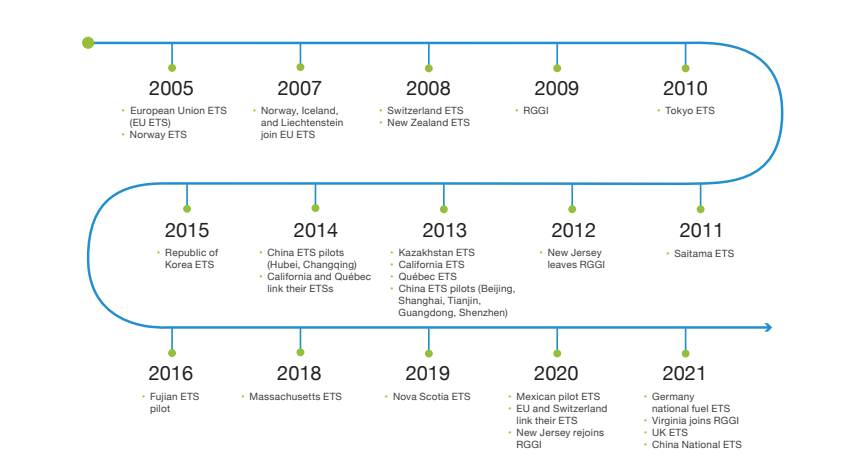
## APPROACHES TO CARBON PRICING; EMISSIONS TRADING AND CARBON TAXATION

Carbon pricing aims to increase the cost of emitting carbon dioxide and other greenhouse gases, ensuring that those involved in the market factor in the actual expenses related to emissions when making business choices. (UNFCCC, 2021)This approach encourages both businesses and households to alter their production and consumption patterns, leading to reduced emissions. Companies will strive to minimize expenses tied to carbon pricing by investing in the most economically viable methods of emission reduction. Simultaneously, consumers will shift towards lower-emission goods as these become more competitively priced. (Global, 2020) When it comes to carbon pricing, countries have two primary avenues: carbon taxation and emissions trading systems (ETS), also referred to as "cap-and-trade." These approaches vary in several aspects. Under a carbon tax, regulators establish a price for greenhouse gas (GHG) emissions, which will decrease based on how covered participants react to the economic signal provided by the tax. (Elkins, 2008)In contrast, under an ETS, regulators restrict the permissible volume of GHG emissions, employing either a fixed or adaptable cap. (Mehling, oct 2018) The price for GHG emissions results from the market balance established between this limit imposed in GHG emissions (the cap) and the demand for emitting GHGs. (worldbank.org, Putting a Price on Carbon with an ETS, 2020) Participants are required to surrender emission rights corresponding to their emissions. Trading enables participants to buy and sell these emission rights.

### 2.1 Emissions Trading

### 2.1.1 Introduction

An emissions trading system (ETS), also known as "cap and trade," stands as a significant tool for carbon pricing. This approach places a limit (cap) on the overall emissions within specific sectors of the economy and provides tradable allowances that do not surpass the cap. Typically, each allowance corresponds to one metric ton of emissions. Entities subject to the ETS can engage in trading these allowances, creating a market value for them. The 1997 Kyoto Protocol initially introduced the concept of trading emissions or emission reductions among its member countries. (McKibbin, 1999)Subsequently, in 2005, the European Union (EU) and Norway adopted domestic ETSs, (climate.ec, 2005) and Japan launched a voluntary trading initiative to fulfill its Kyoto commitments. (Hango, 2008) Since then, greenhouse gas (GHG) trading has expanded, with different regions employing various designs and strategies, as illustrated in Figure 2.2. As of 2023, there have been 28 distinct ETSs either implemented or in progress globally. Article 6 of the December 2015 Paris Agreement emphasized the importance of voluntary cooperation among countries for mitigation efforts. (Soezar, 2022)This signal is expected to hasten the adoption and interconnection of ETSs, further promoting the spread of carbon pricing.



**Figure 2.2 source: World Bank (WB, 2023)**

### 2.1.2 The Environmental Prospects of Emissions Trading for Pakistan

**Setting the emissions cap**

Emissions cap or Total Emissions Units refer to the total amount of GHG emission allowed by the regulator to be emitted per year and different jurisdictions that have set up an ETS have made the cap such that it gets lowered each year so that GHG emissions could be mitigated efficiently. Given the substantial uncertainties surrounding future economic expansion, particularly in industrial production, an Emissions Trading System (ETS) implemented in Pakistan would require a cap that can be flexibly adapted based on product output. This adjustable cap would be contingent upon the actual production levels of the covered entities, resulting in what could be termed a “double-adjustment” mechanism, characterized by the following considerations: Intensity-Based Cap, the size of the cap would be attuned to the tangible production of the entities under coverage. In essence, this entails adjusting the cap according to the specific output metrics such as electricity generation, cement manufacture, or the volume of carbon-intensive goods produced or processed; Gradual Stringency Adjustment, over time, the strictness of the cap would be modified to align with the envisaged ambition of the ETS. This adjustment would be gauged in terms of the number of allowances allocated per unit of product. In other words, the cap’s rigor would be attuned to the ETS’s overarching objectives and level of ambition. (Tsai, 2020) Hence, an adaptable cap framework anchored in product output would be imperative for a Pakistani ETS, effectively accommodating the uncertainties in economic growth and industrial activity while ensuring the system’s efficacy and responsiveness to evolving emission reduction targets.

In 2030 the country projected GHG emissions would reach 1603 MtCO2 eq and Pakistan in its NDC 2016 has committed to cut the emissions by 50%, of which 15% will be done from the country’s own resources which amounts to 240.45 MtCO2 eq. The energy sector combined with the energy demanding Transport sector was emitting 270.2 MtCO2e in 2018. (NDC, 2021)The target of 240.45 MtCO2e can be achieved within 5 years of setting up a cap in energy sector, standing at 270 MtCO2 in 2018, that gradually lowers each year, such as; 200 MtCO2e in the first year as Total Emission units allowed for energy sector with the subsequent years of cap as 160 MtCO2e, 110 MtCO2e, 55 MtCO2e and 55 MtCO2e in the 5th year. This contributes to mitigating 240 MtCO2e in five years fulfilling the Pakistan’s 15% unconditional cut in GHG emissions.

As an example of Alberta TIER ETS, the total emissions in the jurisdiction (2021) are 256 MtCO2e and the share of jurisdiction’s GHG emissions covered in ETS is 57.99%. Their Cap or total emission units (current year or latest year available, ETS only) are set at 159 MtCO2e (2020). (WB, 2023)

## 2.1.3 The Economic Prospects of Emissions Trading for Pakistan

**Allocation of Allowances**

To ease the impact to participating industries in the form of increased production costs, in a first phase of the ETS the allocation of allowances could be based partly on “grandfathering” and partly on benchmarking. But in the later years of ETS, Allocations would be auctioned to generate revenue for the government and ensuring that the polluter pays for the damages inflicted due to climate crisis caused by GHG emissions. In the scenario of Pakistan adopting a domestic Emissions Trading System (ETS), it is probable that during the initial phases, allowances could be distributed without charge to covered entities. This aligns with the prevailing trend in global ETS development. However, as the ETS matures and participants become more experienced, the practice of gradually replacing free allowance allocation with auctioning is expected to emerge. This transition would result in an additional revenue stream for the government.

**Utilization of revenues**

To gauge the revenue potential of the ETS, consider a situation where the ETS cap encompasses 120 of Pakistan’s largest emitting facilities. Assuming 10% of the allowances within the system are auctioned at a conservative price of $2.5 USD per unit, this could yield an annual revenue of $42 million USD. This revenue could be channeled to the recently established Pakistan Climate Change Fund. It’s assumed that this fund would predominantly support climate-related actions, whether focused on mitigation or adaptation, thereby aligning with the core rationale for implementing emission pricing.

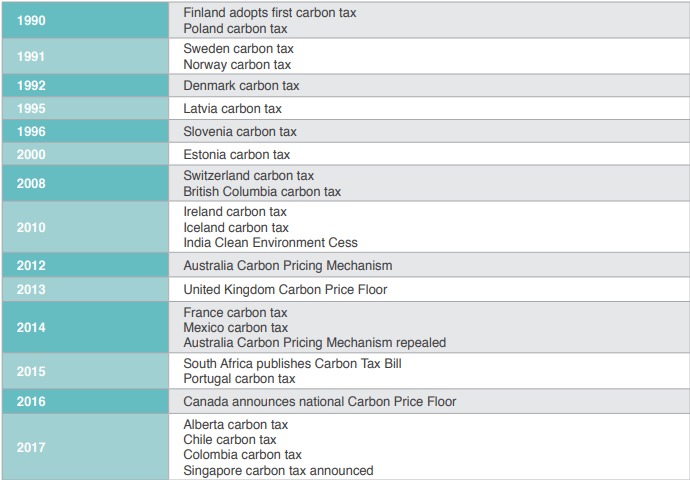
### 2.2 Carbon Taxation / Direct Pricing

### 2.2.1 Introduction

Carbon taxes serve as a method for pricing greenhouse gas (GHG) emissions by imposing charges on products or activities based on the emissions they generate. This approach encourages taxpayers to decrease their emissions to lower their tax responsibilities. For industries, a carbon tax could prompt investments in cleaner technologies or more efficient practices. Consumers might be motivated to enhance energy efficiency, alter their behaviors, or transition to cleaner energy sources where feasible. In energy markets with flexible pricing passed on to consumers, carbon taxes can stimulate higher demand for renewable energy among both consumers and industries. (Morris, 2013) This could lead to investments in renewable sources like wind, solar, and hydro power. Simultaneously, carbon taxes offer governments a revenue source that can be channeled into increased public spending or reduced taxes in other areas. (Ekins, 1996)

Carbon taxes have been present since the early 1990s, preceding the establishment of the United Nations Framework Convention on Climate Change (UNFCCC). These taxes were among the initial tools utilized to target greenhouse gas (GHG) emissions reduction. Originating primarily in the Nordic countries, Finland led by introducing the inaugural carbon tax in 1990. (Samuel Jonsson, 2020) Subsequently, Norway, Sweden, and Denmark adopted similar measures in 1991 and 1992. Notably, the Nordic carbon taxes, initiated in the early 1990s, continue to operate today. (Roger Hildingsson, 2022) From the late 2000s onward, a revived and expanding interest in implementing carbon taxes has emerged. Switzerland's introduction of a carbon tax in 2008 prompted several other European nations, as well as developed countries such as Australia and Japan, to explore and adopt similar strategies. The early 2010s marked a significant juncture, as emerging economies like South Africa, Mexico, and later Chile and India, embraced carbon taxes as part of their climate policy endeavors. (WB, 2023) In the context of the Paris Agreement, over 150 countries have already submitted their (Intended) Nationally Determined Contributions (NDCs) aimed at combating climate change. Table 2.1 shows all the countries that have either implemented or are scheduled to have the implementation of carbon taxation as climate mitigation as of 2023.Many of these nations are integrating carbon taxation, alongside other strategies, to realize their emission reduction objectives.

**Table 2.1 source: World Bank (WB, 2023)**



## 2.2.2 Environmental prospects of Carbon Taxes for Pakistan

Applying techniques like difference-in-differences, synthetic control, and introducing a novel econometric break detection method, researcher Felix Pretis unveiled compelling evidence of certain sectors effectively curbing their CO2 emissions following the implementation of a carbon tax in British Columbia, Canada. (Pretis, Does a Carbon Tax Reduce CO2 Emissions? Evidence from British Columbia, 2022) Notably, this evidence pointed to a substantial reduction in emissions within the transportation sector, the predominant source of emissions within the taxed region. The proposed approach, utilizing panel econometric break detection, effectively pinpointed the BC carbon tax’s role in diminishing transportation-related emissions. However, the identified noteworthy declines in overall CO2 emissions across Canadian provinces did not correlate with the rollout of the BC carbon tax or the carbon pricing initiatives in Alberta and Quebec.

## 2.2.3 Economic prospects of carbon Taxes for Pakistan

**Sector Wide Carbon Tax**

A comprehensive carbon tax on the entire energy sector involves implementing a tax on greenhouse gas (GHG) emissions applicable to both businesses and end-users. This approach bears similarities to the carbon tax in place in British Columbia, Canada, since 2008, which serves as a model for a wide-reaching, economy-wide carbon tax. This tax is collected from all businesses and individuals who purchase or utilize fuel within the province. It is imposed “downstream,” meaning it is levied at the point of purchase by end-users. (Rhodes, 2013)

Creating an instrument along these lines would not only align with the core aim of carbon pricing—to explicitly introduce an economic indicator in the form of a price on GHG emissions—but also provide the government with an additional revenue stream through the taxation. To offer an estimate of the potential revenue generation from an economy-wide carbon tax implementation in Pakistan, assuming it could be uniformly applied to GHG emissions from the energy sector in 2018 with tax rates ranging from 1 to 5 USD/tCO2e, the resulting revenue would span from 62.68 to 313.4 billion Rs. This amount corresponds to 0.434% to 2.17% of the federal budget for the fiscal year 2022-23. This calculation considers: i) 270.2 MtCO2e emitted from the energy sector in 2018; ii) a federal budget of 14.46 trillion Rs. For the fiscal year 2022-23; and iii) an exchange rate of 300.56 PKR per USD.

**Carbon tax on coal**

Coal, being the fossil fuel with the highest carbon intensity, has seen its utilization remain relatively modest in Pakistan (comprising 44.5 percent of the overall primary energy supply during FY 2021-22). (Finance, 2022) Nonetheless, its portion has been on a consistent upward trajectory in recent times. While Pakistan has historically been a net coal importer, the nation is rich in native coal reserves, particularly in the strategic Thar coalfield situated within Sindh Province. Numerous endeavors aimed at harnessing these domestic resources are progressing through diverse stages of development, indicating a notable potential for a considerable expansion of coal’s role within the energy mix in the forthcoming years.

In Pakistan, the implementation of a levy on coal is a possibility worth considering. From a technical perspective, its implementation could be relatively straightforward and involve minimal administrative expenses, especially if applied “upstream” at the points of coal production and import. However, given coal’s relatively small portion of the energy consumption in Pakistan, a stand-alone coal tax might lack the potency to drive the required transition towards low-carbon development. Nonetheless, such a tax could contribute to controlling the growth or even reducing coal consumption in Pakistan. Moreover, a coal tax could present an extra avenue for government revenue. For instance, by drawing inspiration from the current tax imposed in India (around 5.7 USD per metric ton of coal) and aligning it with coal consumption in Pakistan during the fiscal year 2021-22 (amounting to 15.418 million tons), this approach could potentially yield revenue of 63.8 million USD.

## 2.3 Conclusion

In conclusion, introducing a tailored Emissions Trading System (ETS) in Pakistan presents an opportunity to achieve several positive outcomes. This includes accelerating the adoption of eco-friendly energy sources and improving energy efficiency, areas with substantial untapped potential in Pakistan. It also aids in bolstering energy security, promoting efficient fossil fuel use, and expanding renewable energy capabilities. The implementation of a carbon pricing mechanism could attract international investments in sustainable technologies and provide an additional revenue stream through emissions allowances. Furthermore, it enables accurate monitoring of GHG emissions, crucial for tracking progress towards National Determined Contribution (NDC) goals. Addressing local air pollutants, often coinciding with GHG emissions, is an added benefit. Additionally, connecting with carbon pricing mechanisms in other regions, as outlined in Article 6.2 of the Paris Agreement, is a valuable opportunity. Tradable emission units offer a convenient means to facilitate emissions rights exchange. Given the baseline year of 2015 and a projected 2030 emission of 1603 MtCO2eq, Pakistan's commitment to achieving a 50% reduction, especially in the energy sector, is vital. The introduction of an ETS covering major emitting facilities can be a key instrument in achieving this reduction target. This approach not only aligns with global climate goals but also has the potential to generate substantial revenue, offering a multi-faceted solution to Pakistan's emissions challenge.

In formulating strategies to reduce greenhouse gas (GHG) emissions and achieve policy objectives, policymakers must carefully evaluate a range of policy instruments, whether deployed individually or in combination. If the consideration leans towards implementing a carbon tax, there arises a necessity to project the potential consequences based on different design choices. It is also imperative for governing bodies to periodically gauge the practical impact of the tax and explore options for potential tax adjustments. The successful reduction of CO2 emissions in certain industries following the introduction of a carbon tax in British Columbia, Canada, particularly within the transportation sector, underscores the effectiveness of this policy. The proposed approach, utilizing panel econometric break detection, successfully attributed the reduction in transportation-related emissions to the BC carbon tax. Estimating the potential revenue from implementing an economy-wide carbon tax in Pakistan, with varying tax rates and based on emissions from the energy sector in 2018, reveals significant revenue potential. Implementing a levy on coal in Pakistan could be relatively straightforward and involve minimal administrative costs, offering an additional avenue for revenue generation. Carbon taxes hold substantial revenue-generating potential, with even a moderate tax having the capacity to accumulate a significant percentage of a country's Gross Domestic Product (GDP) in various nations. This demonstrates the multifaceted benefits and potential of carbon pricing policies in addressing both environmental and economic objectives.