EXECUTIVE SUMMARY

The number of countries that have announced some type of commitment to net zero emissions has increased very rapidly in recent years, from five in 2018 to over 145 in 2023. Many of these are middle-income countries (MICs) and low-income countries (LICs), whose greenhouse gas (GHG) emissions are concentrated in the power sector. As domestic electricity demand grows, these countries must increase power generation while reducing carbon emissions to meet socioeconomic needs and align with the Paris Agreement's goal of limiting global temperature rise to 1.5°C. Therefore, the power sector must increasingly rely on low-carbon energy sources.

LICs and MICs must therefore consider policies to both grow and decarbonize their power sectors. A growing number of them are considering carbon pricing instruments (CPIs), such as carbon taxes and/or emissions trading systems (ETSs) to transition to low-carbon electricity systems, as part of a broader policy mix. There is ample international experience of applying CPIs across the world, and many lessons can be learned from it. However, most of this experience is concentrated in advanced economies, and the use of carbon pricing instruments is still very limited in LICs and MICs.

The structure and energy mix composition of power sectors in LICs and MICs vary substantially, but share common challenges distinct from those faced by advanced economies. These include rapid growth in electricity demand, low levels of access and affordability, insufficient and insecure supply, and lack of affordable financing, among others. Such challenges require a different set of public policy choices compared to advanced economies. **A literature review confirms the gaps that exist in developing economies to introduce carbon pricing.** This report aims to fill some of the identified knowledge gaps and assess the role that CPIs, specifically carbon taxes and ETSs, can play in supporting decarbonization of the power sector. The report also provides actionable recommendations for policy makers considering implementing a CPI in their countries.

Well-designed carbon pricing in the power sector could support:

i. A shift toward lower-carbon generation, driven by price signals that direct decisions on investments and retirements of power sector assets, and improved energy efficiency and fuel adjustments in existing power plants (medium- and long-term impact).
ii. A shift in dispatch toward lower-emissions power generation, including by changing merit order and accompanying flexibility resources (short-term impact).
iii. A shift toward less carbon-intensive wholesale electricity purchase, including distributors, retailers, and/or large customers contracting the purchase of electricity from renewable energy producers (short- and long-term impact).
iv. A shift toward less carbon-intensive consumption patterns, including by changing the time of consumption, investing in battery storage, reducing on-grid demand by improving efficiency, or adopting behind-the-meter renewables (short- and medium-term impact).
v. Raising new fiscal revenues, which, if directed appropriately, can facilitate the transition to a lower-carbon power sector.

These insights are validated by 10 years' experience of the Partnership for Market Readiness and emerging evidence from the Partnership for Market Implementation, as well as consultations with various power sector and carbon pricing experts and specific case studies. The selected case studies include China (ETS), Colombia (carbon tax), Kazakhstan (ETS), and South Africa (carbon tax) and cover a series of characteristics

and challenges frequently met in LICs and MICs (e.g., state-owned monopoly power utility, high coal reliance, issues with affordability, insecurity of supply, etc.).The findings also shed light on the specific role that carbon pricing can play within the wider energy transition happening in these countries.

CPI OPTIONS FOR MULTIPLE POWER SECTOR STRUCTURES

The value chain of the power sector, composed of five main stages—fuel supply, generation, wholesale transmission and dispatch, distribution and retail, and consumption—contributes to the sector's emissions. Compared to other sectors, the power sector tends to be highly regulated along its value chain, due to the sector's unique economic traits. These include the natural monopoly of its transmission and distribution networks, rigorous system stability requirements, and long lag times between investment decisions and the availability of power to balance future supply and demand. At each stage of this value chain, economic agents make investment, sales, dispatch, purchase, or consumption decisions based on existing incentives and obligations. These incentives are shaped by national laws defining the sector's structure, as well as regulations, taxation and subsidies. Therefore, introducing a new carbon pricing instrument adds to the existing complexity of incentives.

Power sector reforms in developing countries have led to varied and diverse structures, ranging from fully state-owned utilities to competitive markets. Since the 1980s, many LICs and MICs reformed their power sectors by liberalizing and unbundling to encourage private sector participation and introducing competition to increase efficiency, reducing political interference and subsidies, and attracting private capital. The outcomes of these reforms varied significantly among HICs, LICs, and MICs and resulting into I diverse power sector structures, ranging from fully integrated state-owned public utilities to fully competitive markets.

The structure of a country's power sector significantly influences the economic agents at each stage of the value chain and their decision-making priorities, leading to variations in the policies and instruments, including carbon pricing, used to reduce emissions.

International experience shows that ETSs and carbon taxes can be designed to target different groups of stakeholders at different points of regulation along the value chain.

- ***When a CPI is applied at the generation stage***, electricity generation companies either surrender emission allowances or pay a carbon tax based on their direct emissions. This leads to an additional operational cost for higher-emitting plants.
- ***A CPI, at the dispatch stage*** includes the carbon price either as a separate cost or in the cost curve submitted by generators, affecting the merit order.
- ***At the distribution stage***, distribution and/or retail companies pay a carbon price proportional to the carbon content of the electricity they procure, encouraging contracts with low-carbon sources. This regulation incentivizes companies importing electricity to purchase from lower-carbon sources.
- ***Lastly, at the consumption stage***, a CPI is applied to the consumer's electricity bill based on the consumption-weighted emission factor of the grid. This can be done through an ETS, with caps based on a consumer's Scope 2 emissions (i.e., those that result from the purchase of electricity consumption) or through a carbon tax based on the carbon content of the electricity consumed, prompting consumers to alter their usage patterns or invest in energy-efficient appliances.[1]

[1] If the market structure allows, large consumers could also respond by signing bilateral power purchase agreement contracts with low-carbon electricity producers.

The effectiveness of a CPI also depends on its interaction with existing incentives and regulations at each value chain stage, influenced by other policy challenges.

A CPI applied at one stage of the value chain can influence the decisions made either upstream or downstream of the regulation point, although the structure and regulation of the industry matters for the pass-through of incentives. A CPI applied at the point of electricity consumption, for instance, with a tax based on average carbon content, can influence consumption patterns. However, it does not directly impact dispatch or supply mix decisions—although it will eventually influence these by changing the shape and the size of the load curve to be served and the marginal capacity to be dispatched. Conversely, applying the CPI at the fuel combustion stage in power generation sends a clear signal for investment and dispatch decisions. Depending on the structure and the regulation of the sector, this may be passed through to consumers, potentially influencing their consumption patterns and investments in energy efficiency.

Finally, in certain cases, combining multiple CPIs along the value chain may be worth considering. Regulators often introduce regulations along the value chain to address market failures or to internalize specific public policy objectives, which can create rigidities and hamper the pass-through of the carbon price signal to other stakeholders. As a result, multiple CPIs might be necessary at different points in the value chain to ensure **adequate incentives to all agents involved.**

LESSONS AND RECOMMENDATIONS

The main findings of the analysis conducted in this report can be organized into a series of lessons and recommendations to help achieve the expected outcomes.

Lesson	Recommendation
Role of CPIs in the decarbonization of the power sector in LICs and MICs	
Challenges faced by power sectors in LICs and MICs differ from those in high income countries. Policy landscapes for deploying CPIs are therefore different, influencing their role and design.	LICs and MICs' challenges need to be identified and acknowledged early to ensure that CPI role and design can take these into account, while minimizing the risk of adding hurdles and maximizing opportunities.
Governments have a wide variety of policy instruments and reforms at their disposal to drive decarbonization of their current and future power sector. The role of carbon pricing needs to be defined within this broader policy mix taking into account overlapping policies.	A CPI-based policy should be designed as part of a broader sector decarbonization policy package, supported by a thorough analysis of potential complementarities and/or redundancies with other decarbonization policy instruments.
Different CPIs for different power sector structures	

The power sector is a complex, highly regulated value chain, offering a variety of potential regulation points and design options for CPIs, delivering different impacts on the decisions of the agents along the chain to decarbonize the sector	Governments should consider different potential regulation points and choose based on the assessment of which stage of the value chain the CPI can the most effectively influence to move the sector toward a lower carbon intensity, considering the country's specific circumstances.
The structure of the power sector will have a potentially strong and distinct incidence on the effectiveness of different types of CPIs.	The sectoral scope and the governance of the CPI should be adjusted to the structure of the power sector.
Designing CPIs to ensure effectiveness, minimize undesired impacts and maximize co-benefits	
For a CPI applied at a determined point of the value chain to have an impact on the emissions of the sector, it must provide a signal that is strong and predictable enough to influence the decision processes at that point and possibly beyond.	Designing and calibrating the level of CPIs to achieve reductions must be based on a diagnosis of the switching values that can change the outcome of the decisions made at the regulation point and beyond. Driving investments requires decision-makers to have an ability to anticipate the evolution of the carbon price.
A carbon price may interact with other policies in the power sector and thus be designed accordingly to prevent reducing its effectiveness or generating negative consequences.	It is necessary to investigate and simulate potential interactions with other existing regulations that influence the formation of electricity. It is equally important to embed in it features that address context specific undesirable effects or inefficiencies.
Political economy challenges and learning curve	
In systems that are constrained by a lack of generation capacity, a carbon price may lead to higher electricity costs without achieving emission reductions.	In capacity constrained systems, decarbonization efforts should focus on behind the meter response and future system development. When centrally planned, a shadow carbon price can be considered into planning.
A carbon price can be politically challenging to implement, but strategies exist to overcome political hurdles. The design of the recycling of the carbon revenue is an essential part of it.	The generation and the recycling of carbon revenues should be part of the design since early stages. Regular consultations at design, assessment and successive adjustment stages are critical for both correctly anticipating their response and agreeing on measures to address undesired impacts.