

Effect of Carbon Pricing on Global Environmental Sustainability and Economic Development Part II

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Abstract

This paper presents a critical strategic analysis of international carbon pricing and its environmental, economic, and social impacts. It examines and reviews the impact of carbon taxes and emissions trading systems (ETS) on the reduction of greenhouse gas (GHG) emissions, technological innovation, and structural change over the long term through systematic literature review and content analysis. This study also considers distributional equity, competitiveness, administrative capacity, and carbon leakage risk and concludes that a carbon price is not a pillar to be used to attain the level of decarbonization that would be needed to meet international climate targets but a complementary pillar that should be combined with stronger regulatory, fiscal, and industrial policies. Global cooperation, better policy formulation, strategic revenue application, and emphasis on social equity are thus important in the effectiveness and legitimacy of carbon pricing at the international level.

Keywords: Carbon pricing, Emissions trading system (ETS), Carbon tax, Climate policy, greenhouse gas mitigation, Just transition. Carbon leakage, Revenue recycling, Climate governance. Low-carbon innovation.

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1. INTRODUCTION

Climate change has ceased being an environmental concern and is a characteristic economic, social, and governance problem of the twenty-first century (Intergovernmental Panel on Climate Change, 2022). Increasing world temperatures, the increasing intensity and frequency of extreme weather, and escalating climate-related economic risks may be significant threats to economic stability, development trajectories, and social well-being in various areas. Governments have in turn turned to policy tools that could deliver high levels of emissions cuts but could be economically effective and politically feasible. Carbon pricing has become one of the most important tools in climate policy due to its theoretical effectiveness and use

in various sectors and technologies (Stiglitz & Stern, 2017).

Carbon pricing is meant to internalize the social cost of greenhouse gas (GHG) emissions by including damages associated with climate change in the market price and to harmonize the decision-making of the individual sector with the aggregate social welfare objectives. Economic theory suggests that to encourage firms and households to decrease carbon intensity, switch to cleaner technologies, and redirect investment to lower-carbon alternatives, the price on emissions can be implemented at a lower overall cost than control policies (Aldy & Pizer, 2015). With this argument, carbon taxes and emissions trading systems (ETS) have

emerged and are currently being implemented in over 70 locations (World Bank, 2023).

Despite the increase in carbon pricing, global emissions are still increasing, and current carbon pricing frameworks apply to less than a quarter of global GHG emissions, with prices too low to meet the aspirations of the Paris Agreement (Jakob *et al.*, 2015). Such discrepancy between expectations and the actual results begs significant questions about the circumstances under which the price on carbon will be able to provide significant levels of emissions reduction without increasing inequality or making economies less competitive.

However, there are limited studies that examine environmental, economic, and social impacts in combination, with skewed attention to the high-income economy. A synthesized, context-sensitive model that determines the influence of political and institutional reality on the results of different jurisdictions is also absent.

This paper is part two. It is based on the theoretical and methodological foundation of Part 1 (Olawore *et al.*, 2026) and synthesizes evidence in the field globally between 2007 and 2024 to determine the real-life performance of carbon pricing, regional differences in performance, and new forms of governance. The aim is to find out the political, institutional, and design characteristics that facilitate effective, fair, and sustainable decarbonization.

Despite the current literature being able to identify a lot of the contextual factors that influence the outcome of carbon pricing, there is less systematic explication of the fact that similar policy designs take dramatically different political courses, between gradual strengthening and abrupt reversal. This review fills that gap by formulating and implementing a dynamic policy feedback framework. From this perspective, carbon pricing is not viewed as a predetermined policy tool but as a process that is subject to change through continuous political engagement. Long-term performance will be determined by how cost and benefit will be introduced and experienced over time and whether this sequencing will attract support or create opposition. By using this feedback-based method, the analysis goes beyond just listing the relevant conditions. It looks at how they interact and strengthen each other over time, which affects both the long-term success and the goals of carbon pricing policies.

1.2 Research Questions

- What economic, institutional, and political circumstances can result in the enduring cutbacks on the emission of greenhouse gases through carbon pricing?
- What are the impacts of changes in the structure of carbon pricing instruments on the economic

performance, innovation, and carbon leakage risks?

- How do revenue recycling and just transition affect the equity outcomes, the acceptance of the policy by people, and the sustainability of the policy?

These questions collectively put carbon pricing into perspective, not as merely an economic tool, but as a governance tool, which is a part of the national development policy and international climate policy.

1.3 Research Objectives

- To compile the evidence of empirical studies carried out since 2007 on the environmental efficacy of carbon pricing in various national and regional settings.
- To determine the economic, innovation-related, and distributional impacts with regard to the alternative carbon pricing designs.
- To determine the policy courses that can enhance equity, legitimacy, and cross-border coherence in the process of transforming the economy to low-carbon economies.

1.4 The Contributions to the Academic and Policy Literature

This paper contributes to the existing literature on carbon pricing in four ways and is based on the theoretical and methodological background laid out in Part 1 (Olawore *et al.*, 2026). To start with, it provides a systematic and integrative review of the world evidence between 2007 and 2024 based on peer-reviewed empirical studies and trustworthy policy reviews in a broad scope of political and developmental contexts (Dobbeling-Hildebrandt *et al.*, 2024). Second, it develops a multidimensional analytical model that analyzes the correlation between price levels and institutional capacity, as well as revenue use and complementary policies with respect to environmental, economic, and social outcomes (Hepburn *et al.*, 2020). Third, it puts the political economy and distributive considerations in the middle of the analysis and proves that governance and equity are the key determinants of policy effectiveness and not the secondary factors (Klenert *et al.*, 2018). Lastly, the paper offers policy-relevant recommendations to both developed and developing economies based on the ways to enhance ambition and maintain social legitimacy and economic resilience (Organization for Economic Co-Operation and Development, 2023).

By analyzing carbon pricing not as a technical instrument of the economy but as a political and institutional instrument, this study adds to a more practical perspective of climate policy as a means of fostering sustainable and inclusive development in the ever-dispersed global governance environment.

2. Theoretical and Conceptual frameworks.

This section presents a combined conceptual framework of studies on the impacts of carbon pricing on the environmental, economic, and social performance of the jurisdiction. Instead of considering carbon pricing as a technical policy tool, the framework places it in the context of the wider tradition of environmental economics, political economy, and the just transition literature. This view is indicative of an increased appreciation of the fact that the success of climate policy does not solely rest on efficiency issues but also on distributional consequences, institutional capacity, and political limitations. The framework fills a gap in the current literature, which typically viewed efficiency, equity, and feasibility as analytical issues (Hepburn *et al.*, 2020; Pahle *et al.*, 2018).

2.1 Economic Principles of Carbon Pricing.

Carbon pricing has an economic rationale, which is the Pigouvian welfare economics. This strategy assumes that we can correct market failures due to negative externalities by adding social costs to the private costs. Greenhouse gas emissions are an exception to this model: the emitters are not experiencing the economic and environmental losses of climate change. Governments attempt to internalize these damages in the market by imposing a fee on carbon, either in the form of taxes or tradable permits, and to motivate firms and households to reduce their emissions (Nordhaus, 2019).

Efficiency-wise, carbon pricing will reduce the overall cost of mitigation since it will allow emissions reductions to occur where they are most cost-effective. This is an advantage that pricing tools have over control-based regulation. Even though carbon taxes and emissions trading systems (ETS) have the potential to achieve the same results, their actual operation is predetermined by the institutional framework, the price predictability, and the trust of the market system (Stavins, 2022).

Carbon pricing also has an impact on investment in the long term. The studies of induced technological change reveal that the credible and sustained price signals affect the innovational strategies of firms, stimulating them to invest in low-carbon technologies and assist the technologies in disseminating over time (Marin *et al.*, 2023). Such dynamical influences are important in decarbonization in the long-term scale, especially in cases where the short-term abatement decisions are limited, and future cuts depend on technology.

2.2 Political Economy of Carbon Pricing.

Despite the efficiency benefits noted in the economics, the political-economy studies provide the answer to the question of why carbon pricing can be met with a lot of resistance or low ambition. Carbon pricing has a direct effect of increasing the costs of energy, production, and household expenditure. It generates

concentrated losses to the carbon-intensive industries and visible expenses to consumers, and, as a result, it leads to political resistance that can reduce price levels, limit coverage, or undermine enforcement in the long run (Jenkins, 2014).

Studies in political economy have demonstrated that the results of policies are more than efficiency. Results are also determined by the interest-group pressure, electoral incentives, trust in state institutions, and the perceived competitiveness that might affect the reluctance of the companies to the pricing policy and the resistance of the household to the policies that they consider unfair or retrogressive. Governments tend to respond to these pressures by providing exemptions, rebates, or compensation schemes, thereby decreasing the environmental performance of the policy (Pahle *et al.*, 2018).

Policy credibility is vital. Businesses would increase their investments in low-carbon technology if they believed that carbon pricing would remain stable. Political competition or regular changes of policies also undermine investment signals and deter mitigation results (Pizer & Aldy, 2016). Thus, the performance of the carbon pricing regimes is centered on institutional stability and political legitimacy.

2.3 Just Transition, Distributional Justice.

An emerging body of literature claims that carbon pricing should not be assessed based on efficiency. In the absence of compensatory policies, an increased energy price may put a disproportionate burden on low-income households because they allocate a greater proportion of their income to energy and transport. These impacts increase inequalities and undermine popular support of climate policy (Carattini *et al.*, 2018).

The concept of just transition can be applied to households, to workers, and to regions that are reliant on fossil fuels. Uncontrolled adjustments can result in unemployment and reduced economy in some of these regions. Studies emphasize the value of revenue recycling, retraining, and social protection policies to assist the unemployed workers and keep the society together (International Labour Organization [ILO], 2015).

Justice issues are also an international problem. Most developing economies have limited fiscal resources, poor administrative ability, and are more sensitive to changes in energy prices. Equal pricing of carbon without subsidies on a financial and technological basis is likely to increase global disparities. This problem has prompted the demand to harmonize carbon pricing, climate finance, technology transfer, and the principle of differentiated responsibilities in global climate deals (Klinsky & Winkler, 2018).

2.4 An Integrated Framework of Carbon Pricing Effectiveness.

This paper considers carbon pricing effectiveness as the outcome of complementary economic incentives, political limitations, and social

factors. The framework below summarizes these interactions and assists in an explanation of why similar pricing instruments would produce different results in different jurisdictions.

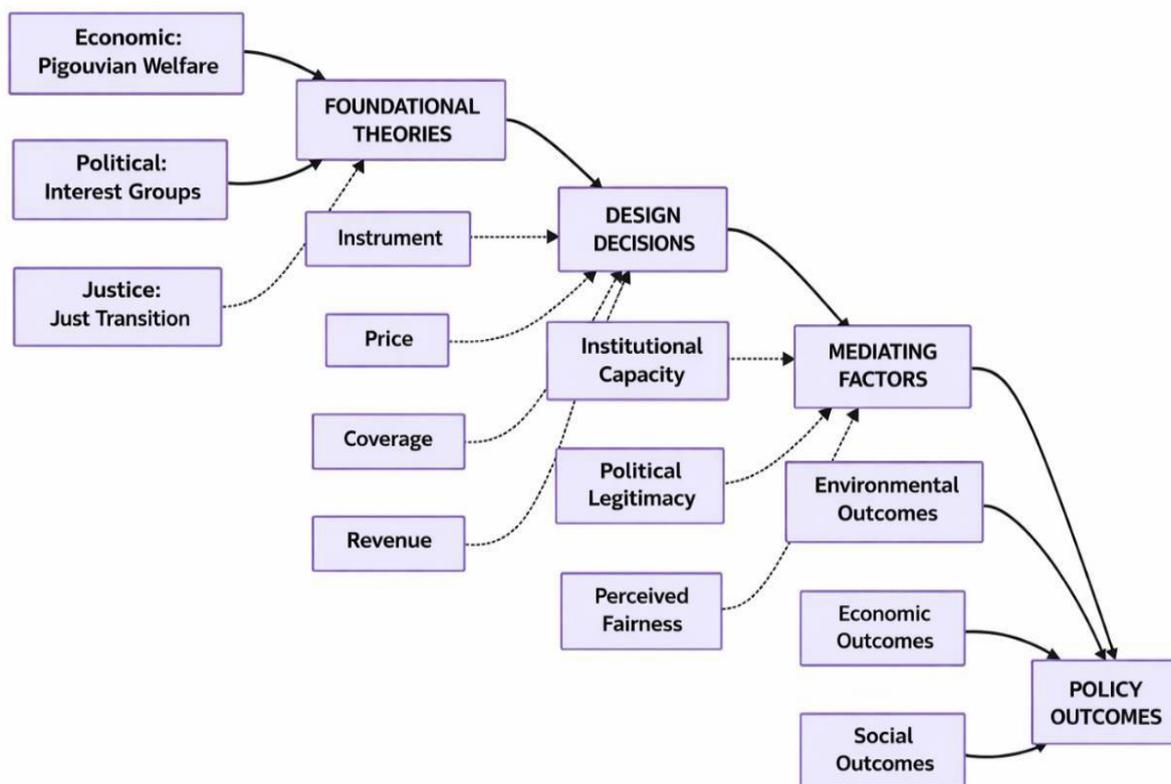


Figure 1: Illustrates the influence of fundamental opinions on economics, politics, and justice on choosing carbon pricing design and the effect of such decisions on policy outcomes by the capacity of institutions, political trust, and a sense of fairness

The framework demonstrates the influence of foundational theories on the key design decisions of carbon pricing policy. These decisions are mediated by the institutional capacity, political legitimacy, and equity issues. The aspects determine the transformation of policy design into environmental, economic, and social effects.

The concept of carbon pricing is viewed as a political-economic institution and not a technical tool in this context. It relies on its efficiency, legitimacy, and perception of fairness as well as coordination with other policies. The following sections focus on the comparative analysis and empirical synthesis based on this view.

3. Methodological Approach: A Systematic Integrative Review.

This paper is a systematic integrative review of the evidence of carbon pricing outcomes across the world between 2007 and 2024. The review clarifies the

procedure for implementing carbon pricing and the circumstances that result in varying outcomes. The strategy used in this analysis is a realist synthesis, where the interaction between the price of carbon and contextual factors like the institutional capacity, structure of governance, and political economy is examined to influence the outcome of different jurisdictions (Pawson *et al.*, 2005). The PRISMA 2020 guidelines were followed to conduct the review to guarantee transparency and methodological rigor (Page *et al.*, 2021).

3.1. Search Strategy and Screening.

Our literature review was based on peer-reviewed articles published between 2007 and 2024, which we searched with a multi-database search (Scopus, Web of Science, and Google Scholar). The search involved the use of keyword strings that were associated with carbon pricing instruments and their environmental, economic, and social impacts. The supplementary material presents the complete search plan. The

screening process was rigorous and is detailed in the PRISMA 2020 flow diagram (Figure 2). After removing duplicates, titles and abstracts of 3,291 records were

screened against the inclusion criteria. The full text of 856 articles was then assessed, resulting in a final corpus of 165 studies for qualitative synthesis.

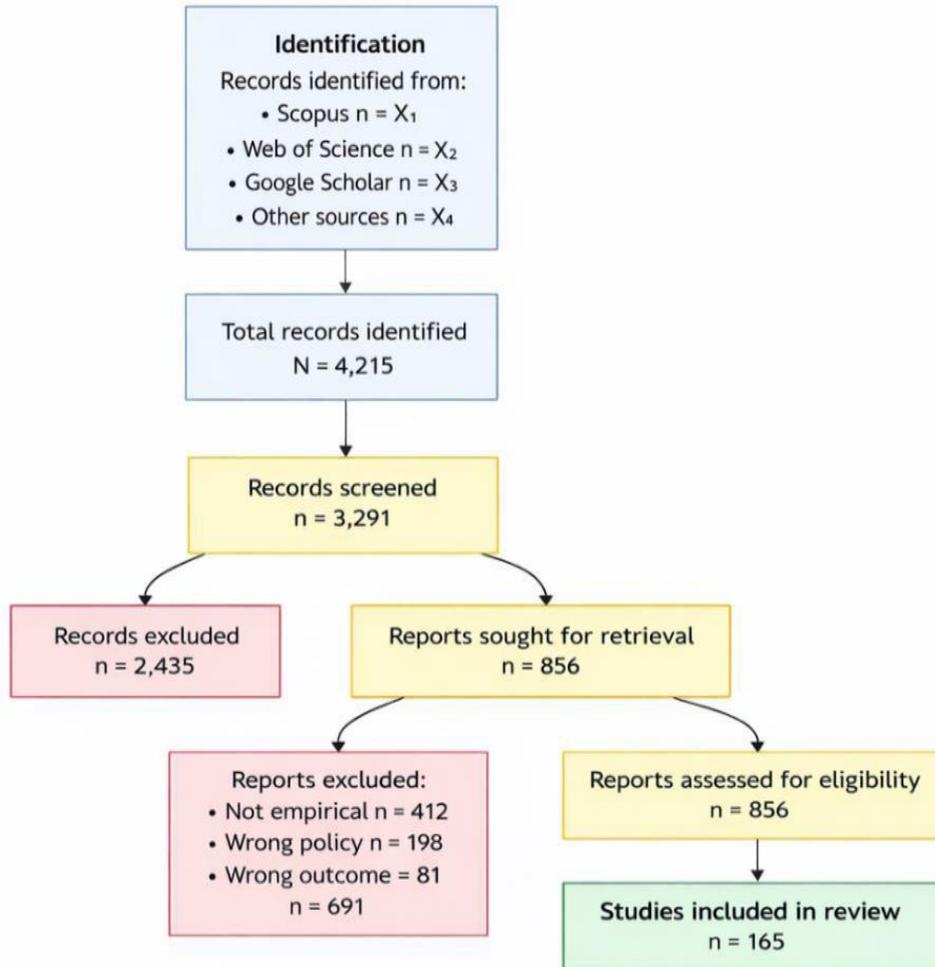


Figure 2: Study selection process. PRISMA-based flow diagram illustrating the identification, screening, eligibility assessment, and final inclusion of studies in the systematic review.

3.2 The study focused on the inclusion criteria and the process of data extraction.

To guarantee the analytical relevance and empirical quality, three criteria were used to select the studies. First, both studies performed an empirical study, be it quantitative, qualitative, or mixed method, on a carbon pricing tool that had already been implemented, i.e., carbon taxes, emissions trading systems (ETS), or hybrid solutions. Second, all of the studies considered at least one of the core outcome dimensions: environmental (e.g., greenhouse gas emissions), economic (e.g., innovation, competitiveness, growth), or socio-political (e.g., distributional effects, public acceptance, revenue use). Third, peer-reviewed journal articles, books, and book chapters were the only ones considered.

The studies were filtered out as either being purely theoretical or modeling-based, without empirical

validation, centered on policies that were yet to be implemented, or commentary or non-peer-reviewed literature. Relevant data were then extracted in a standardized template within the Covidence software for each of the included studies. The extraction was used to retrieve bibliographic information, jurisdictional settings, and features of policy design, methodology, and major findings. (Page *et al.*, 2021; Thomas & Harden, 2008).

3.3 Introduction to the Evidence Base.

The last sample consists of 165 studies covering a large variety of carbon pricing jurisdictions and research themes. Such studies illustrate a high degree of geographical heterogeneity and methodology. Table 1 is a summary of the evidence base, including its distribution in regions and methods of analysis.

Table 1: Scope of the Included Evidence Base (n=165 studies)

Jurisdictional Focus	Primary Instrument(s) Studied	Approx. No. of Studies	Common Methodologies
European Union & United Kingdom	EU ETS, National Carbon Taxes	58	Econometric analysis, Ex-post evaluation, CGE modeling
North America (Canada, USA)	Subnational ETS, Federal/Provincial Taxes	41	Comparative case study, Longitudinal analysis, Survey research
Nordic Countries	High-Rate Carbon Taxes	22	Patent analysis, Techno-economic study, Policy process tracing
East Asia (China, Japan, S. Korea)	National & Pilot ETS, Carbon Tax	28	Quasi-experimental design, Sectorial analysis
Emerging Economies (Chile, SA, etc.)	Carbon Taxes, Emerging ETS	16	Distributional impact analysis, Political economy case study

Table 1. Shows the 165 reviewed studies are concentrated in Europe and North America, where carbon pricing is most established, leaving emerging economies underrepresented (World Bank, 2023). Methodologies also differ regionally, with econometrics common in EU studies, case studies in North America, and political economy analysis in developing regions (Jakob *et al.*, 2015), highlighting both evidence strengths and gaps in the literature. (Work).

3.4 Analytic Synthesis: Thematic and Comparative Synthesis.

The synthesis was a two-fold process that passed through descriptive aggregation into explanatory interpretation.

At the initial phase, qualitative thematic synthesis was done according to the approach of Thomas and Harden (2008). Results were coded line by line in order to indicate repeated descriptive themes like a small-scale short-term emission cut or worries over industrial competitiveness. These preliminary themes were narrowed down by comparing them to further analytic themes, which represented patterns in the literature, such as the effect of revenue use on political acceptance.

The second stage employed a comparative case-study methodology, based on George

Bennett (2005). Jurisdictions were classified into similar groups, with a high level of carbon price or federal systems with high subnational action. These groups were compared with each other and with their own internal states in order to understand the interactions between policy design and contextual states. This methodology detected recurrent mechanisms and moderating variables of successful and fair pricing on carbon, which have a direct impact on the research question in the study.

3.5 Methodological Limitations and Mitigation Strategies.

This type of review has several limitations.

To start with, it is difficult to separate the impact of carbon pricing from other parallel policies (such as renewable subsidies and efficiency standards). The latter approach was solved by placing more

emphasis on counterfactual or quasi-experimental design studies and viewing policy packages as explicit contextual factors in comparative analysis (Döbbling-Hildebrandt *et al.*, 2024).

Second, the distribution of the literature is not even across the geographical areas, with a heavy concentration on the OECD countries. This imbalance was recognized, and the inferences were strictly confined to the environments where the pieces of evidence were discovered (Jakob *et al.*, 2015; World Bank, 2023).

Third, a formal meta-analysis is not possible due to the variety of methods, sources of data, and outcome measures of the studies. The integrative and comparative approach was employed to derive inferences of variation by identifying patterns and reasoning causally instead of considering this heterogeneity as a constraint (Pawson *et al.*, 2005; Thomas & Harden, 2008). Such methodological decisions offer a clear and believable basis for the synthesis and further discussion of the policy.

4. Global Ambition, Carbon Pricing Instruments and the Place of Context.

This part compares the principal carbon pricing tools carbon taxes, ETS, and hybrid methods in the context of an ongoing disconnect between the current policy ambition and the need to reduce emissions. In accordance with the evidence of 2007-2024 and the political-economic structure of Part 1 (Olawore *et al.*, 2026), it is shown that the differences in the results depend primarily on the contextual factors, such as the price levels, institutional capacity, and political design, rather than the official choice of instruments. The effects on the environment and socio-economic factors should primarily lie in the way pricing instruments are applied and integrated into the larger framework of governance.

4.1 Carbon Taxes: Price Certainty and Political Challenges.

Carbon taxes provide a fixed price per tonne of CO₂-equivalent, and the result is a definite and predictable guide in making investment decisions. This certainty in prices is often referred to as the main

economic advantage in situations when the futures of tax paths are realistic and foreseeable (Metcalf, 2019).

The existence of carbon taxes can be proved by the empirical evidence, and it is important to note that the reduction of emissions might happen through carbon taxes, but only under certain conditions. In Sweden, with tax levels high enough to hit about USD 137 per tonne, there have been large emissions reductions since 1990, and economic growth has been maintained (Andersson, 2019). The results stem from the tax level, the extensive coverage of the sector, and the choice of how to use the revenue.

Carbon taxes mainly face the issue of visibility and distributional effects as a major political problem. Unless there are compensatory measures, increased energy prices would disproportionately affect the lower-income households, undermining the strength of public support in the long run. It has been shown that regressive effects can be compensated through recycling revenues in the form of lump-sum rebates or targeted transfers and that this remedy can increase acceptance (Carattini *et al.*, 2018). Contrastingly, sectoral exemptions, which were frequently brought about due to political considerations, were likely to water down environmental effectiveness and minimize overall policy effectiveness.

4.2 Emissions Trading Systems: Governance Complexities and Policy Credibility.

ETS is based on a quantity limit: a limit on the overall emissions at which the price is determined by market trading. In theory, this approach results in the lowest cost for achieving environmental outcomes. Practically, institutional design and policy adjustments have been very critical to the performance of ETS. These challenges were observed in the early years of the EU ETS (2005-2012), when political bargaining on permit allocation, weak price signals, and low-carbon investment incentives were the main factors in the large-scale over-allocation of allowances and high price volatility (Koch *et al.*, 2014).

Their evolution points out the importance of governance arrangements. Reforms such as the Market Stability Reserve (MSR) vary the amount of allowances provided to the market when market forces shift, and the EU ETS prices tend to remain more stable in the range of between 80 and 100 (European Commission, 2023). Such evidence demonstrates that emissions trading systems require an active administration and not a self-

regulated market. Effective monitoring, reporting, and verification (MRV) systems and policy decisions that strike a balance between competitiveness issues such as free allocation and the need to maintain incentives to reduce emissions are crucial for their effectiveness (Pahle *et al.*, 2018).

4.3 Hybrid Systems Flexibility and Administrative Requirements.

Hybrid carbon-pricing mechanisms incorporate price-based and quantity-based instruments to address the shortcomings of each method (Newell, Pizer, & Raimi, 2014). An example of a price ceiling and price floor system of trading is the California program (CARB, 2023). Another example is a carbon tax that changes based on how well an industry is doing. These designs will provide investors with greater price certainty and, at the same time, strive to maintain environmental objectives (IMF, 2023).

The theory that hybrids are effective in situations where abatement costs are uncertain is proven, with a federal price on carbon and output-based pricing for highly polluting and trade-exposed industries in Canada offering flexibility in politics and a powerful national price signal (IMF, 2023). But hybrids are administratively complicated. Their implementation, monitoring, and adjustment demand high regulatory potential and restrict their application to locations with weaker institutions.

4.4 The Political-Economic Ambition Gap in Measures.

Although the number of carbon-pricing tools is increasing, there is still a significant disparity between the present ambition and the cuts required. By 2023, over 70 jurisdictions around the world had established carbon pricing mechanisms covering approximately one-third of all global greenhouse gas emissions (most of which were assessed to be much less than the coverage that would be necessary to meet the aims of the Paris Agreement by 2030) (Stiglitz & Stern, 2017; World Bank, 2023). As demonstrated in Table 2, high prices and wide coverage are uncommon and highlight the variation of ambition in different regions.

According to studies, low prices of under US\$30-40 per tonne (as cited by the High-Level Commission on Carbon Prices) do not produce much impact on investment (Stiglitz & Stern, 2017).

Table 2: Shows the Carbon Pricing Ambition Gap, the current reality and the Paris-Aligned Goals of 2030.

The Jurisdiction (Instrument)	Current Price (USD/tCO ₂ e)	The Paris Target Range (USD/tCO ₂ e)	The Assessment in Plain Terms
Sweden (Carbon Tax)	137	50–100	Leader-Has already surpassed the pricing of Paris and has excellent climate commitment.
EU (ETS)	90–110	50–100	Strong performer Within or above the target range, showing compliance.

The Jurisdiction (Instrument)	Current Price (USD/tCO ₂ e)	The Paris Target Range (USD/tCO ₂ e)	The Assessment in Plain Terms
Canada (Federal Carbon Tax)	65 (rising to 170 by 2030)	50–100	Ambitious trajectory the price is now moderate, although it is projected to rise beyond benchmarks.
California (Cap-and-Trade)	~30	50–100	The project is gaining momentum, which is an important start, but it should be strengthened considerably to achieve 2030 objectives.
China (National ETS)	<10	50–100	The initial price indicator is not strong enough at the moment; there should be a significant buildup of Paris alignment.
Global average (weighted)	~22	50–100	Critical gap the world continues to value carbon at less than half the rate proposed by climate science.

Table 2. Show the current carbon prices relative to the suggested range of USD 50–100/tCO₂e recommended by the High-Level Commission on Carbon Prices to be applied in 2030 (Stiglitz & Stern, 2017). The Global weighted average is the coverage of price in the applied systems of carbon pricing as of 2023/2024 (World Bank, 2023).

This gap is due to political and economic problems, not technical ones. Low prices of carbon have consistently been linked to the issues of competitiveness, distributional impacts that have not been resolved, and lack of international coordination. Empirical and policy-based research persistently suggests that the effects of carbon prices of less than about USD 30–40 per tonne of

CO₂ equivalent have been limited to influence the degree of investment in innovation and infrastructure needed to achieve deep and sustained decarbonization standards based on the High-Level Commission on Carbon Prices (Stiglitz & Stern, 2017; Edenhofer *et al.*, 2019).

4.5 Key Determinants of Success: Synthesis.

Within the last twenty years, there is no single carbon pricing tool that has been effective in all situations. A tax that is well managed and with a high price may yield better results than a trading system that is low priced and deployed in a fragmented manner. The performance is based on a combination of factors, as shown in Table 3.

Table 3: Determinants of Carbon Pricing Effectiveness beyond Instrument Choice

What matters	Why it matters (in plain English)	What the evidence basically says
A high-enough carbon price	The price must be sufficiently high to shift corporate investment to clean technologies and speed up the process of eliminating polluting infrastructure.	At low prices, between \$30 and \$40 per ton, this is not something that is likely to spur a great deal of innovation or fundamental structural change, especially in heavy and capital-intensive sectors. (Edenhofer <i>et al.</i> , 2019).
Governance and enforcement capacity	The carbon price can be effective only in cases where the rules are credible, implemented and dynamic otherwise firms will remain until the end or they will bend the system.	The EU ETS was much more effective when the market was tightened by governance reforms (such as the Market Stability Reserve) and again trusted by years of excess allowances and poor prices. (Pahle <i>et al.</i> , 2018).
Fair revenue use and smart political design	Carbon pricing becomes acceptable when it appears reasonable to the people and the households gain. This kind of support is what makes policies survive.	It has been demonstrated that revenue recycling (particularly, direct household dividends) can increase popular support without reducing incentives to reduce emissions (Carattini <i>et al.</i> , 2018).
Wide coverage across the economy	The more sectors involved, the less loopholes and the more the economy can reduce emissions at reduced total cost (and reduced leakage).	The first market phase of ETS in China is a relevant case study of the significance of scope of coverage: by focusing the coverage on the power sector, the system has achieved few economy-wide emissions reductions in comparison to its nominal size (World Bank, 2023).
Instrument choice (tax, ETS, hybrid)	This defines the way price is delivered, taxes provide price certainty, ETS may provide certainty, and hybrids combine the two.	Taxes or ETS is not always the best tool, and the question of an effective instrument is more about the capacity of the state, politics, and the policies behind it than about the type of instrument.

Table 3. It is crucial to note that the tax-versus-trading debate is irrelevant when considering the success of carbon pricing, but five key conditions can help achieve success: adequate price signals (Edenhofer *et al.*, 2019), strong governance (Pahle *et al.*, 2018), fair use of revenues (Carattini *et al.*, 2018), comprehensive sector coverage (World Bank, 2023), and context-specific design that suits the situation in a particular country.

Carbon pricing is therefore not a tax decision or a market mechanism. It is a policy that is influenced by social, political, and institutional forces. Its success depends on its ambition and its ability to fit within a plausible framework. The following sections below discuss these factors and their impact on emissions reductions, innovation, and distribution.

5. Empirical Findings of the Effectiveness of Carbon Pricing.

This section provides a literature review of peer-reviewed studies published since 2007 on the practical implications of pricing carbon. The analysis integrates the results of the quasi-experimental studies, panel data, and recent meta-analyses using the systematic review methodology in Section 3 and the framework presented in Part 1 (Olawore *et al.*, 2026). It prioritizes emissions, economic performance, innovation, and social equity and discusses these aspects based on evidence instead of theory.

5.1 Emissions Reduction Results Design and Ambition.

The empirical data show that the outcomes of the price on emissions are statistically significant but not the same. Carbon price levels and design specifications are closely associated with the outcomes. In 2024, Dobbeling-Hildebrandt *et al.* carried out a meta-analysis that discovered that 21 schemes have a 5-21% decrease in the post-implementation; the strongest relationships, representing more effective mitigation, are linked to higher prices, as well as a greater degree of coverage (Section 4.4).

Country-level studies establish this information. Andersson (2019) employs the tax variation in Sweden to find that raising rates decreased transport emissions without negatively impacting economic growth. The same outcomes can be observed in the EU, where the subsequent stages of the EU ETS with stricter caps and price-balancing reforms are linked to a reduction in emissions covered by 37 percent since 2005 (European Commission, 2023). All these findings indicate that carbon pricing may be a feasible mitigation measure when it is adopted with high ambition and plausibility.

5.2 Economic Performance, Competitiveness, and Risk Mitigation

One of the anxieties that policy debates express is that carbon pricing is detrimental to economic performance or competitiveness. These effects are not

common as seen at the macro-level. At the firm level, such as Dechezlepretre *et al.*, (2023), the EU ETS does not have any considerable adverse effect on productivity, profitability, or survival when free allocation and output-based benchmarks are taken into account. These findings are that, when properly designed, carbon pricing can restrain the competitiveness costs within the transition window.

Macroeconomic studies indicates that carbon pricing typically has small growth effects, and that they are not statistically significant. The impact is also rather restricted in case the revenues are reused effectively. The concept of a price on carbon as a double dividend, i.e., spending the revenue on carbon pricing on reducing distorting taxes on labor or investment, continues to be highly theoretical and partly supported by empirical data. Trade-exposed sectors will still be subject to concerns about carbon leakage, where activities that are intensive in terms of emissions are relocated to areas with weaker climate policies. However, leakage is generally lower than that initially estimated. These results confirm the necessity of better international coordination and the presence of other tools that should complement these, such as carbon border adjustments, as explained in Section 4.

5.3 Long-term Effects on Innovation and Technological Change

Beyond reducing emissions in the short term, technological change will also justify carbon pricing. It is growing clear that carbon pricing can influence innovation to pursue technologies that are lower-carbon. As an example, a study by Marin, Vona, Consoli, & Popp (2023) revealed that an increase in the price of carbon by one dollar in the future is associated with a 1.4% increase in patent applications of low-carbon technologies within two years. This impact is high in cases where policy signals are consistent and believable. Firms are comfortable enough in such places to leverage riskier R&D.

These findings support the notion that carbon pricing enhances dynamic efficiency. Rather than a cost on the emissions, it transforms relative returns and is a guide to technological investment. The innovation response is slow, but it is essential in reaching greater emissions reductions than what the current technologies can achieve.

5.4 Policy Design and Its Distributional and Social Impact.

The distributional impacts of carbon pricing are dependent on the policy. Household surveys time and again indicate that in the absence of any form of compensation, increasing the price of energy is retrogressive, as low-income households dedicate a greater portion of their income to energy. There are indications, however, that prudently deployed revenues can help reverse this retrogressive effect. (Carattini,

Carvalho, & Fankhauser 2018) discovered that *regressively* can be reversed by specific recycling, in particular, uniform lump-sum rebates, and their acceptance by the population can be increased.

The effects in the labor market also depend on the policies that come with it. Although decarbonization can lead to the disadvantage of the workers and those areas that depend on fossil fuels, a study has shown that job losses are not necessarily unavoidable. Studies, including the International Labor Organization (2015), have identified that active labor market policy, retraining,

and regional development have helped the affected workers and made transitions. These are social aspects that are closely related to the political backing and the stability of carbon pricing in the long run.

5.5 Synthesis: A Comprehensive View of the Results.

Table 4 is a synthesis of the key empirical results of the review. It connects observed results to the moderating variables in the conceptual framework and demonstrates the effects of design characteristics and contextual circumstances on environmental, economic and social effects in various carbon pricing regimes.

Table 4: Empirical Evidence on the Effectiveness of Carbon Pricing Synthesis.

Outcome Dimension	Core Empirical Finding	Key Moderating Factor (From Conceptual Framework)	Implication for Policy Design
Emissions Reductions	It works, and the effect of the reduction is usually between 5% and 21%, but the magnitude of the effect is highly variable.	Price Level & Policy Credibility	To maximize effect, it establishes a high, increasing, and predictable price path.
Economic Performance	The macro effects are minor; the effects of firm-level competitiveness can be dealt with.	Revenue Recycling & Complementary Policy	Use revenues to ease distortionary taxes and give industry specific aid.
Innovation	There is strong evidence of induced low-carbon innovation.	Stability of policy and long term indicator.	Make sure that the policy lasts longer than the electoral cycle to steer long-term R&D.
Social Equity	Regressive by default but progressive by design.	Revenue Use & Just Transition Measures	Mandate an equitable recycling of revenues (e.g., in the form of per capita dividend) and worker transition.

Table 4. Shows that the findings from a review of 165 studies indicate that carbon pricing can work well for the environment, economy, and society, but certain important factors mentioned in the conceptual framework (Section 2) are essential for it to succeed (Döbbeling-Hildebrandt *et al.*, 2024; Carattini *et al.*, 2018; Marin *et al.*, 2023; Klenert *et al.*, 2018).

The evidence analyzed results in the qualitative conclusion that carbon pricing may be effective, but the success of any policy is strongly dependent on the design and implementation. Environmental, economic, technological, and social performance results are not automatic but are affected by the decisions on the price levels, coverage, revenue utilization, and institutional arrangements. Combining all the results, the paper can argue that carbon pricing is a political and institutional structure whose impacts are contextual and designed rather than the instrument itself.

6. Regional Performance, Environment, and Comparative Performance.

This part provides a comparison of the experiences of carbon pricing across regions with a particular focus on how institutional capacity, political-economic conditions, and policy design drive the results. Similar to the previous analytic system (Olawore *et al.*, 2026), we do not prioritize instruments. Rather, we look

at the interaction of design attributes, particularly revenue use, with local circumstances to produce various environmental and socioeconomic outcomes. In this view, the results will depend on the extent to which the larger governance and equity structures integrate carbon pricing.

6.1 Europe: Institutional Learning and Consolidation of Policy.

The European Union Emissions Trading System (EU-ETS) is the most developed multinational carbon market. Historical evidence of the system demonstrates that gradual learning and policy modifications are effective in improving its performance, as witnessed between 2005 and 2012, when it was marked by undue allocation of allowances, volatility, and a lack of environmental impact. These issues were resolved through reforms tightening emission caps, expanding coverage and institution of a Market Stability Reserve (MSR).

These reforms have been proved to have a material improvement on the system. The MSR and an even tighter post-2020 limit have resulted in more predictable allowance prices, within the EUR 80-100 per tonne range, which strengthens the belief in long-term policy orientation (European Commission 2023). At the firm level, the research results indicate that the overall

emission covered by EU ETS has been reduced, and productivity and competitiveness impacts are relatively small, partly due to transitional instruments such as free allocation (Dechezlepretre *et al.*, 2023). The European example proves that the results of carbon pricing change with time and depend on the long-term political will and ability of the administration.

6.2 North America: Subnational Designs and Strategic Revenue Use.

In the absence of a single federal system of carbon pricing, North America has a patchwork of subnational policies. The cap-and-trade in California and the Regional Greenhouse Gas Initiative (RGGI) in the United States can be seen as opposing models. RGGI is a power-oriented initiative that has reduced emissions, as well as allocated much of the auction income to energy efficiency and other associated initiatives, enhancing the connection between revenue utilization and mitigation (Burtraw *et al.*, 2021). The price floor, which reduces market volatility, has regularly reduced emissions in California's economy-wide system, which connects with Quebec.

Canada has a national hybrid approach. The national carbon price is an emergency measure, which comes into place when provincial plans are not up to national standards. In Canada, the federal carbon price is CAD 65/tonne in 2023, which is going to be increased to CAD 170/tonne in 2030. The previous carbon tax reduction in British Columbia increased fuel consumption by 5–15%. These examples suggest that in the contentious environments, transparency and fair play of revenue are essential in political support and sustainability of policy (Beck *et al.*, 2015; IMF, 2023).

6.3 East Asia: Pricing Carbon in the Large Industrial Economies.

East Asia is confronting the difficulty of implementing carbon pricing in giant high-growth economies. The latest CES introduced in 2021 is the Chinese national emissions trading system (ETS). It was primarily designed to create powerful institutions, data quality, reporting, and compliance instead of high price signals. During the initial stage, which involves the power sector, the price of allowances remains low, typically to less than USD 10 per tonne of CO₂. Pilot programs imply that the system has reduced the carbon intensity of firms primarily due to improved operational efficiency and not structural changes (Cui *et al.*, 2021; World Bank, 2023). As policymakers determine the severity of the emissions cap and transfer the ETS to other industries, its efficiency will increase.

Japan and South Korea have been conservative and have adopted a mix of small prices on carbon, regulatory standards, and targeted promotion of low-carbon technology (Kameyama *et al.*, 2019; World Bank, 2023). These strategies bring a balance between ambition and risk, low prices take the short-term economic and

political pressure at the expense of immediate cuts in emissions. The greatest challenge is the establishment of administrative, monitoring, and enforcement capabilities of large-scale carbon markets in the region (Jakob *et al.*, 2015). Thus, stepwise implementation is a feasible, even though slow, solution.

The table highlights one of the important aspects of this review. Although the policy is a major factor in terms of choosing a tool like a tax, ETS, or a hybrid, it is the details of the design and governance that affect the results mostly (Stiglitz & Stern, 2017; Pahle *et al.*, 2018). The gains for the environment would be dependent on an ambitious but credible and long-term policy path. Administering, applying, and transforming the institution over time determines its quality. In addition, the treatment of distributional impacts, particularly through revenue use, has a tremendous impact on political support and policy sustainability (Carattini *et al.*, 2018; Klenert *et al.*, 2018).

Therefore, policymakers are more concerned with establishing the governance capacity, political goodwill, and structure needed to manage the price efficiently than with the choice between deploying a tax or an ETS (Pizer & Aldy, 2016; Hepburn *et al.*, 2020).

6.4 Developing and Emerging Economies: A Tradeoff between Feasibility and Equity.

The decisions on carbon pricing in developing and emerging economies are highly dependent on their development priorities, distributional issues, and institutional capacity. The experience of early adopters, like South Africa, which has a carbon tax, and Chile, which has a carbon emissions trading scheme, demonstrates that carbon pricing can be efficient but difficult to adopt in such a situation. Distributional effects are a major issue in such environments. Equity balancing is a key to the political and social sustainability of pricing policies since families with low income are more likely to spend more of their income on energy.

Despite the lack of empirical data compared to developed economies, the available literature indicates that deeming emission reductions an important objective is difficult. In the meantime, social and political risks are also significant. The carbon pricing may reinforce the existing inequalities or cause political backlash, which may halt or reverse the policies unless there is a solid support tool, such as cash transfers or higher social expenditures (Jakob *et al.*, 2015). Therefore, it is necessary to balance carbon pricing with more development agendas, social safety nets, global climate investments, and capacity building.

6.5 Cross-Regional Comparisons: Developing Patterns and Lessons.

The comparative analysis identifies the common factors that determine carbon pricing outcomes in different regions. Despite variations in institutional

settings and policy decisions, we can observe certain trends in terms of price ambition, administrative capacity, revenue utilization, and political tolerance.

Table 1 presents these associations in a summary and guides the general conclusions of the review.

Table 5: Comparative Report on Regional Carbon Pricing Performance.

Region (Key Example)	Primary Governance Strength / Focus	Key Design Feature for Success	Central Challenge / Constraint
Europe (EU ETS)	A learning governance and institutional adaptation.	Constant reformation (e.g., the Market Stability Reserve) that reinforces market confidence and the price stability.	The focus is on maintaining ambition and managing fairness among the different member states.
North America (Canada, RGGI)	Subnational innovation and workable design politically.	Transparent, transparent utilization of revenues to develop popular support and legitimacy.	There is political fragmentation and an inability to provide consistent, economy-wide coverage.
East Asia (China's ETS)	Rolled out and capacity building.	Developing effective monitoring, reporting, and verification (MRV) and enhancing compliance within a complicated economy.	Increasing price ambition with a low starting point to spur more profound emissions reduction.
Developing economies	Equity and development integration	Linking the policy to social support in order to not target lower-income households the most.	This has reduced the administrative capacity and the challenge of following up on climate objectives and poverty reduction.

Table 5. This comparative analysis shows the effectiveness of carbon pricing in terms of the peculiarities of regional governance, adaptive governance, and institutional learning. These are the sources of European success (Pahle *et al.*, 2018); subnational innovation and transparent revenue reuse are the sources of North American power (Carattini *et al.*, 2018); phased capacity building is the key to East Asian success (World Bank, 2023); and developing economies should integrate pricing with equity and development priorities (Jakob *et al.*, 2015).

7. Just Transition Frameworks: Helping Regions and Workers.

Carbon pricing is an effective mechanism to decrease emissions, but it may also place a massive burden on employees, companies, and areas that rely on carbon-intensive sectors (Pizer & Aldy, 2016). The existence of such concentrated costs can cause great political risks: when people feel that their jobs or communities are at stake, they will tend to rebel, and the full payoffs of climate stability can hardly be observed in everyday life. Thus, the carbon pricing policy in the long term should combine a clear package of the just transition with the policies that would mitigate the distributional effects, maintain social cohesion, and make the policy politically sustainable. Decarbonization generates a complicated labor market change. New employment opportunities may be created in low-carbon industries, but they may also disappear in high-emission industries. There are indications in North America that at the economy-wide level, carbon pricing has a (typically) neutral or even positive effect on employment. However, the loss of jobs may be high in the emissions-intensive,

trade-exposed industries and in the areas where these industries are highly concentrated (Yamazaki, 2017).

What is at stake is evidenced by the coal phase-outs in Appalachia (US) and Alberta (Canada). When the support is not credible or timely, the workers may find themselves unemployed over an extended period, the local economy may undermine, and the political backlash may be nearly assured.

The just-transition literature is shifting into practical advice on what exactly support entails. Most of the frameworks are based on four pillars, which are interrelated (IPCC, 2022; Vona, 2023) and are built on the foundations of the international principles of the ILO, including the Guidelines on a Just Transition (ILO, 2015), and supported by comparative evidence.

The former pillar is concerned with income and mobility support. It incorporates wage insurance, long-term unemployment benefits, and relocation benefits as a buffer of the short-term shocks. The second pillar revolves around retraining and skills development, which will make sure that reskilling is in line with actual demand in expanding low-carbon sectors like renewable energy, energy efficiency, and sustainable infrastructure. The third pillar facilitates the diversification of regional economies by using public investment to help affected areas attract new industries and reduce their dependence on fossil fuels. The fourth pillar is the focus on social dialogue and governance that makes sure that workers, unions, employers, communities, and local governments are substantially engaged in planning and delivery.

One of the common messages of this research is that when transition support begins early and is bespoke to local circumstances, as well as connected to broader industrial and innovation policies, then it is most

effective, rather than being regarded as a separate compensation program (Vona, 2023). According to this perspective, workforce and regional development are not peripheral matters in the transition itself.

Table 6: Policy Tools and Real-life examples of Just Transition Policy.

Policy instrument	Main purpose	Example	What makes it work
Wage insurance and bridging support	Insures income to employees who lose their jobs to provide time to adapt.	Coal Transition Initiative: temporary income and bridge benefits to coal workers in Alberta and Saskatchewan in the phase-down period in Canada.	Eligibility is clearly defined, funding is separated and delivery is accomplished through the established proven systems of benefits.
Sector retraining programmes	Helps workers move into growing low-carbon industries where jobs are available	The Coal Regions Structural Development program in Germany targets large-scale retraining in Lusatia in the fields of renewable energy and IT jobs.	Employers are aligned with training, qualifications are portable and workers are supported during retraining.
Place-based investment funds	Helps affected regions diversify their economies and create replacement jobs	EU Just Transition Fund (JTF): €17.5bn to carbon-intensive regions in terms of territorial transition plans.	Investment must be focused and responsible through good local delivery capacity, articulate plans and continual monitoring.
Social dialogue mechanisms	Builds local buy-in by involving workers, communities, and industry in decisions	Scotland Just transition commission: an independent body to unite unions, industry, and communities to lead the implementation.	The process is transparent, the participation is organized, and the recommendations are directly converted into the policy decisions.
Community benefit agreements	Ensures host communities share directly in the benefits of new projects	The Climate Leadership Act in New York: The Act mandates 35–40 percent of clean energy investment to serve underprivileged populations, such as employment.	The rules include benefit-sharing, are resource-rich to participate in, and can be independently audited.

Table 6. Summarizes the major just instruments of transition, their objectives and the examples of jurisdictions that have integrated them with carbon pricing or other decarbonization policies. The instruments mentioned are exemplary and demonstrate the ways in which governments can use income support, retraining, regional investment, and participatory governance to lessen the disturbance of workers and communities throughout economic transition. Source: ILO (2015); Vona (2023).

The example of Germany with Strukturwandel (structural change) in the coal areas demonstrates what a holistic approach may resemble. The phase-out of coal was complemented by a legally set timeframe that would be completed in 2038 as well as a 40 billion euro package to help the affected regions. It also had support in terms of operator compensation, early retirement, and retraining the workers, as well as major investments in infrastructure, research capacity, and business development to lure new industries. Notably, it was facilitated by the multi-stakeholder commissions in the coal areas that contributed to the alignment of the transition plans with the local needs and the establishment of broader legitimacy (Pahle *et al.*, 2018).

The moral of the story is simple: scale, timing, and design are not minor details, as they mainly define whether transition support is believed in and whether it is effective.

An analogous case is provided in Canada. Within the Pan-Canadian Framework, federal pricing of carbon was accompanied by specific action in the industries with intense emissions and trade exposure, as well as by a Just Transition Task Force to address coal-power employees. That task force gave some recommendations that led to the establishment of the Canada Coal Transition Initiative, which was aimed at assisting in skill development, community infrastructure, and diversification initiatives in the impacted communities. It has been evaluated that early engagement and long-term and reliable funding contributed to reducing resistance and made community adaptation easier (IMF, 2023).

Overall, the just transition measures cannot be viewed as the optional supplements to the climate policy. They are the key to the sustainability and validity of the price on carbon and other bold climate policies. An effective transition framework enhances the chances of the policy's stringency being sustained long-term and at high-enough levels to change investment, encourage

innovation, and provide significant emissions reductions. In this respect, the evidence backs up the overall assertion of the paper: the social and political design of carbon pricing is just as vital to success as its economic design.

8. Innovation in Governance and International Coordination.

This part examines three climate-governance domains that have also become popular with the national expansion of carbon pricing: voluntary carbon markets, carbon border adjustment mechanisms, and Article 6 cooperation under the Paris Agreement. Based on the regional comparisons provided in Section 6 and the analytical prism of this review (Olawore *et al.*, 2026), we discuss how these mechanisms should help to address the long-term issues, namely, the need to keep the environment intact, avoid carbon leakage, and promote fairness. They are better in terms of technical design, institutional capacity, and tradeoffs in terms of emissions reduction, equity, and international legitimacy.

New governance arrangements have started to define voluntary carbon markets in response to credibility and integrity concerns. Such projects as the Integrity Council of the Voluntary Carbon Market (ICVCM) worked out Core Carbon Principles, establishing minimum standards of credit quality with an emphasis on baseline setting, permanence, and monitoring. An accumulating literature recognizes several conditions that are commonly regarded as the key to credibility in voluntary markets, such as consistent and standardized measurement, reporting, and verification (MRV); a more precise separation between offsetting residual emissions and contributions to climate finance; and transparent and science-based corporate disclosure practices. Trencher *et al.* (2024) observe that learning and diffusion may be encouraged through corporate involvement, although they need to implement and enforce integrity regulations. Quality credits can be used to fund mitigation in difficult-to-abate sectors and in the developing world but cannot substitute direct cuts in corporate activities and energy systems.

8.2 Carbon Border Adjustment Mechanisms: Leakage and Distributional Issues.

CBAMs are developed as a reaction to the threat of carbon leakage, in which the production with higher emissions will relocate to those regions with less stringent climate regulations. CBAMs target the competitiveness issues caused by carbon prices in domestic industries. The first large-scale application is the European Union CBAM, which is in its transitional stage, and at first it was applied to imports of iron and steel, cement, aluminum, fertilizers, electricity, and hydrogen.

Economic modeling shows that CBAMs can cut down leakage within the targeted sectors to a considerable level. They are also designed in a way that

brings about concerns of governance and fairness. One of the recurring issues is that they might affect the emerging economies, which might have limited access to capital, technologies, and administrative abilities. Cosbey *et al.* (2019) claim that the implementation of CBAMs without additional support may increase inequalities in the world and contradict the principle of common yet differentiated responsibilities of the Paris Agreement.

Therefore, there is a firm connection between legitimacy and long-term viability and the implementation of CBAM. The research finds certain design characteristics to mitigate the negative distributional impacts, such as reinvesting the revenues to support the economies that are affected by the trade, offering technical and financial support to maximize the MRV potential, and providing clear implementation timelines to allow the economies that are affected by the trade to adapt. CBAMs presented as pure trade protection will be more apt to create conflict, whereas those integrated into more universal cooperative approaches can work to create increased and more concerted global ambition.

8.3 International Cooperation: Article 6, Accounting, and Coordination.

Article 6 of the Paris Agreement provides an international cooperation framework based on a market-based approach and a non-market approach to provide a way to achieve cost-effectiveness and greater ambitions. The achievement of this potential relies on accounting rules and institutional trust. The primary governance issue is the risk of the possibility of double counting, whereby the same reduction of emissions is counted by both the country that produces the credit and the country that uses the credit towards the mitigation target.

Schneider and LaHoz Theuer (2019) consider corresponding adjustments as a protective measure. These adjustments would mean that the host countries must deduct transferred mitigation outcomes from their accounts of emissions, and thus the reduction would only be counted once. This is to be done through effective implementation, which requires clear registries, uniform reporting standards, and sound tracking systems.

Besides accounting, literature has studied organized cooperation, e.g., the idea of climate clubs, whereby groups of nations make a joint set of standards or minimum policy thresholds and provide mutual benefits to their members. This strategy is described by Nordhaus (2015) and is designed to solve the problem of free riders in global public goods by enhancing incentives to participate in them and discouraging non-compliance.

Later on, coordination mechanism ideas for differentiated international carbon price floors became popular. Some work by the IMF and other models

indicates that tiered minimum prices (differentiated among advanced, emerging, and low-income economies) would capture the difference in national capacity and would minimize issues of competitiveness and provide more accurate signals to foreign investors. The express intention of these strategies is to reduce the ambition gap that constrains the efficiency of single-country action on climate change.

8.4 Effectiveness of Governance and Policy.

The governance tools mentioned here address most of the political and coordination challenges that have restricted global carbon pricing. They do not make small changes but define the way the pricing systems operate and how they are inter-jurisdictional. Table 1 lists their roles, the issues they raise, and the conditions that lead to their success.

Table 7: New Innovations in Climate Governance.

Governance mechanism	Main goal	Key challenge	What's needed for it to work fairly
Voluntary carbon markets (VCMs)	Bring in private finance for emissions reductions and deal with hard-to-eliminate emissions	Making sure credits are real (additionally, permanence) and avoiding green washing	Clear, tough quality standards (e.g., ICVCM Core Carbon Principles) and transparent rules for corporate claims
Carbon border adjustments (CBAMs)	Reduce “carbon leakage” and protect domestic industries facing carbon costs	Avoiding the inequitable effects on developing nations and remaining consistent with the WTO rules.	Gradual implementation, proper regulations, and encouragement of trading partners with finance and capacity building.
Article 6 cooperation and climate clubs	Cut the cost of global mitigation and encourage stronger collective action	Avoiding repetition and establishing credibility with participants.	Well-developed international accounting (along with appropriate adjustments) and plausible incentives to participate.

Table 7. Summarizes three governance approaches that overcome typical restrictions of unilateral carbon pricing: each approach has a fundamental issue: voluntary carbon markets must be credible, i.e., have integrity standards (Trencher *et al.*, 2024); carbon border adjustments must be equitable, i.e., face equity issues (Cosbey *et al.*, 2019); and Article 6 cooperation must have sound accounting to prevent double counting (Schneider & La Hoz Theuer, 2019).

Mechanisms need robust accounting to prevent double-counting while maintaining ambition (Schneider & La Hoz Theuer, 2019). Each mechanism presents distinct governance challenges that affect its fairness and effectiveness.

Overall, both national choices and global governance are the keys to the future of carbon pricing in global climate policy because they bring coherence and credibility. The way these mechanisms work will be based on questions of integrity, fairness, and cooperation. They will determine whether or not carbon pricing remains a collection of loosely connected national regulations or becomes an effort that can be coordinated and can lead to long-term decarbonization.

9. DISCUSSION

This part summarizes the key on-point conclusions of the systematic review of global evidence on carbon pricing between 2007 and 2024. Based on the information provided in Sections 5 and 6, we return to the conceptual framework proposed above (Olawore *et*

al., 2026) to understand what makes carbon pricing effective. It has been demonstrated that the results are conditional and context-dependent. Carbon pricing is not a general technical solution or a policy tool, the effectiveness of which is determined by the choice of design, institutions, and broader governance.

9.1 What Works, When, and Why?

In the analyzed studies, there are five common factors that describe the broadness of the observed results. The first factor is the level of prices and their perceived credibility. When people perceive the price trend in the future as credible, high carbon prices lead to increased emissions reduction and innovation. Meta-analyses indicate that there is a close connection between realized cuts and these design characteristics (Dobbeling-Hildebrandt *et al.*, 2024). On the other hand, low or volatile prices do not tend to affect long-term investment.

2. Coverage and enforcement.

Sectorial coverage is low, there are many exemptions, and laxity impedes signal strength and cost-effectiveness. They impose the adjustment costs on the households instead of the upstream emitters, and this raises equity and political issues.

3. Use of revenue and political acceptance.

The distribution of revenue is an issue of durability. Clearly, inefficient, unneeded, and reputable recycling, including uniform per capita rebates, increases popular acceptance and decreases the possibility of overturning the policy (Carattini *et al.*, 2018).

4. Policy complementarity.

Carbon pricing can work effectively when combined with other instruments. Regulations, innovation support, and public investment are used to address the barriers that cannot be addressed by pricing alone, particularly at the time of structural transition.

5. Sequencing and institutional learning.

The successful ones tend to begin slowly. The development of administrative capabilities, demonstration of compensation systems, and allowing institutional adaptation are the precursors of increased price goals. Pahle *et al.* (2018) prove that gradualism promotes political acceptance and stability in the long term.

9.2 Carbon Pricing as a Political and Institutional Process.

The above evidence indicates that we ought to understand carbon pricing as a political process as well as an institutional process, rather than an economic tool. The shift in relative prices and resettling expenses and gains inevitably lead to distributional tensions. Its persistence depends on the institutional trust, the ability of the administration, and its political legitimacy. The perceived credibility of government assistance and their capacity to hold adjustment costs is frequently as big as the level of price itself. This is the reason why policies that would otherwise be efficient theoretically might fail in reality, whereas politically viable designs can deliver long-run results.

9.3 Policy Design and Sequencing.

Another lesson of the comparative analysis is the importance of sequencing. The model does not apply to every situation, but there is a tendency. The initial stages are usually associated with setting up monitoring, reporting, visible compensation, and incremental price adjustments. The coverage increases, the exemption reduces, and the prices rise as the capacity and trust of people increase. The approach of considering carbon pricing as the changing arrangement, rather than the intervention, is in line with the review framework that emphasizes quality of governance and social considerations as the mediators of outcome.

10. Policy Implications

The results of the study have a number of design and implementation implications. They are unique and contingent on the economic environment, the institutional capacity, and the distributional issues. The understanding of disparities between high-income, developing, and emerging economies and the international policy sphere is one of the fundamental findings: carbon pricing can only be effective when the policies are adjusted to the specifics of the local environment and the limits of governance.

10.1 High-Income Economies

In economies with stronger economies, which already have carbon pricing, the key concern is the need to increase ambition without losing political and social backing. The first is to raise the price levels to encourage long-term investment and maintain stability. The most important aspects of emissions trading systems are price-stabilization features. The EU Market Stability Reserve is a reform that demonstrates that predictable and slowly increasing price patterns are more effective in influencing investment decisions than unpredictable or sporadic changes (Pahle *et al.*, 2018).

Second, focus on revenue use. Time and again the literature has associated the public acceptance with the redistribution or giving back of revenues. Progressive recycling, such as equal per-capita rebates, will lessen retrogressive impacts and enhance political support by making benefits apparent to the households (Carattini *et al.*, 2018).

10.2 Developing and Emerging Economies: Feasibility, Equity, and Co-Benefits.

Developing and emerging economies can make carbon pricing more efficient by making it part of a more holistic sustainable development approach. Under these conditions, administrators place greater emphasis on practicability and short-run welfare impacts than high-target prices.

It is the tendency of policymakers to achieve success when they focus on a few large, easily monitored sources, say power plants or cement factories. This plan allows governments to develop administrative and monitoring capacity over time and maintain affordable energy. Since affordability is essential, governments should establish and properly articulate compensation policies such as direct cash transfer, subsidies, or clean-energy access programs prior to the implementation of the policy. This procedure will safeguard households at risk and will foster trust in the population (Jakob *et al.*, 2015).

Political support is further enhanced by linking the revenues of carbon pricing to obvious development. The just transition and development literature indicates that investing in clean cooking, renewable electrification, public transport, and health services would be a way to meet climate objectives and current and immediate improvements in the living standards (ILO, 2015). Carbon pricing in these situations has a better chance of being maintained because they will view it as a direct promotion of social and economic agendas and not as an independent environmental tool.

10.3 Global Climate Governance: Fairness, Integrity, and Coordination.

The global system of governance influences domestic policies on carbon prices. International cooperation forces nation-states to tackle the issue of

carbon leakage, maintain environmental integrity, and establish equitable burden distribution.

These challenges are depicted by carbon border adjustment mechanisms (CBAMs). When they are imposed on an individual basis, they are subject to being considered protectionist and may impose unfair burdens on developing economies. According to literature, their legitimacy depends on the measures that accompany it, including technical and financial aid to enhance reporting, monitoring, and verification (MRV) in trading partners and incentives of cooperative decarbonization (Cosbey *et al.*, 2019). In their absence, border actions will be seen as undermining more trust than increasing global aspiration.

International market mechanisms require strong governance too, and they consist of Article 6 of the Paris Agreement and voluntary carbon markets. Credibility is mandatory to prevent any instances of counting twice, maintain transparent registries, and ensure uniform quality standards (Schneider & La Hoz Theuer, 2019). The voluntary carbon market has bodies such as the Integrity Council that are instrumental in establishing and overseeing these standards.

International carbon-price-floor proposals are increasingly popular as a solution to the issue of competitiveness and bridging the gaps of ambition. The carbon price floors are higher in developed economies and lower in developing economies; this strategy creates a harmonized way forward that recognizes the existing differences in capacity and gives better indications to international investors. This concept is consistent with the principle of common but differentiated responsibility, as shown by the modeling of organizations such as the IMF. Combined, these reflections lead to the conclusion that there are both effective, politically viable, and socially acceptable forms of carbon pricing.

10.4 Where Do We Go from Here? We need to address the key research gaps by 2030.

Despite the fact that this review summarizes a significant amount of evidence between the years 2007 and 2024, some gaps still exist. It will be important to address them to inform the next stage of the carbon-pricing policy, particularly regarding equity, governance, and international coordination (Hepburn *et al.*, 2020; World Bank, 2023).

10.4.1 Solution to the Geographic Evidence Imbalance.

This review brings together a lot of evidence, but it also shows that carbon pricing research is very unevenly distributed across the world, with a lot of it coming from the European Union, North America, and the Nordic countries (see Table 1) (World Bank, 2023; Jakob *et al.*, 2015). This bias constrains our ability to be confident about the performance of carbon pricing in

situations with varying political economies, institutional capacity, and development priorities- so that the evidence base is biased towards situations that do not reflect many countries. Sealing this gap is not a purely academic issue but a key to the development of climate policy that is both fair and efficient on a global scale (Klinsky & Winkler, 2018). Future studies need to focus on rigorous and context-specific evidence of the following underrepresented regions:

Sub-Saharan Africa:

Studies need to shift towards ex-post assessments of early adopters (e.g., carbon tax in South Africa), as well as viability studies of new projects. The questions are the following: How can carbon pricing be designed in a manner that supports rapid development requirements, including access to energy, food security, and employment, and does not undermine them? What are the impacts of carbon pricing on the costs and benefits, particularly in informal economies and to those whose livelihoods depend on subsistence-based livelihoods? And where the administrative capacity is small, simple policy designs and international support of MRV (Monitoring, Reporting, and Verification) can make it work (Jakob *et al.*, 2015; World Bank, 2023).

Small Island Developing States (SIDS):

Carbon pricing can serve not as a mitigation tool but as an adaptation and resilience source of revenue in the case of climate-vulnerable but minor emitters, such as SIDS (World Bank, 2022). Studies ought to consider new tools such as tourism levies or air passenger taxes as a climate resilience fee. Research ought to evaluate the political economy of such tools, their effects on key economic industries, and whether they can be used to take advantage of international climate finance.

South and Southeast Asia (beyond China):

Since carbon pricing is being considered or implemented in such countries as Indonesia, Vietnam, and India, their specific issues should be examined: how to reconcile the rapid economic development, coal phaseout, energy poverty, and sophisticated systems of federal or decentralized governance (World Bank, 2023). Comparative studies in the region would help find effective design solutions.

Latin America (beyond Chile):

The example of Chile can be useful, although more evidence of the region's scale is required on three points: how carbon pricing works with fiscal policy in resource-dependent economies, whether the subnational governments can play a role in the design and implementation, and whether earmarking carbon revenues to forest protection initiatives (e.g., REDD+) can lead to better environmental and social outcomes (West *et al.*, 2023).

Methodological Innovations for These Contexts:

To fill these gaps, it is important to go beyond the econometric approaches that prevail in OECD research and consider a combination of research methods such as data measurement and examination of political and social variables, as well as community research and collaborative projects that help generate sustainable and validated knowledge (Pawson *et al.*, 2005; Thomas & Harden, 2008).

10.4.2 Improved Spatial and Distributional Analysis.

There is a need to have a more detailed spatial and distributional analysis. The national-level incidence studies generally obscure the local and regional imbalances. Further studies need to combine household statistics with information about the transport infrastructure, housing, and labor market to develop equitable and feasible local compensation and transition policies.

10.4.3 Systematic Assessment of Just Transition Instruments.

Third, the systematic evaluation of the particular policy instruments is still deficient despite the significance of the just transition concept. To identify the most effective methods of assisting workers and communities in the face of changes, we must compare the various forms of income support, retraining, and regional investments to identify which are the most effective and which ones have political support in the regions that depend on emissions (ILO, 2015; Vona, 2023).

10.4.4 Behavioral and Integrity Effects of Carbon Markets.

Fourth, there is a need to continue working on the integrity and behavioral impacts of carbon markets, especially voluntary ones. Researchers should use the discoveries about over-crediting and weak additionality to figure out when offsetting really reduces internal emissions and when it just takes their place.

10.4.5 The Interplay between Climate Policy and Trade Policy.

Last, but not least, the interplay between the climate policy and the trade policy should be paid more attention. The overall impacts of carbon pricing, border policies, and industrial subsidies on global supply chains, investment flows, and international cooperation are not well comprehended, at least in the eyes of developing economies (Cosbey *et al.*, 2019; IMF, 2023).

To be able to support the evidence base of effective, equitable, and sustainable carbon-pricing policies, research should be prioritized.

CONCLUSION

This is a global review of evidence to explain why carbon pricing is effective in certain locations and ineffective in others, and the main conclusion is that design does not guarantee success, but it is extremely

conditional. Carbon pricing is effective to cut down on carbon emissions and induce low-carbon innovation, yet only with efficient institutions, fair use of revenues, and other policies.

The main contribution of the paper is that carbon pricing is not merely an economic process but also a political and institutional one. The idea of our dynamic policy feedback framework is to explain how policies change with time- why some become stronger over time and others weaken or reverse. This strategy emphasizes the significance of sequencing reforms, controlling popular perceptions, and developing trust by designing fairly and transparently.

In brief, the price on carbon should be viewed as a component of an even greater social contract. Success cannot be achieved without fairness, credibility, and orientation towards other broader development objectives- not only price levels. Carbon pricing should be ambitious and active to reach a major global decarbonization, and it has to be complemented by just transition and international collaboration policies. Only then can it shift off a set of national policies to become an effective and fair global strategy to address climate change.

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