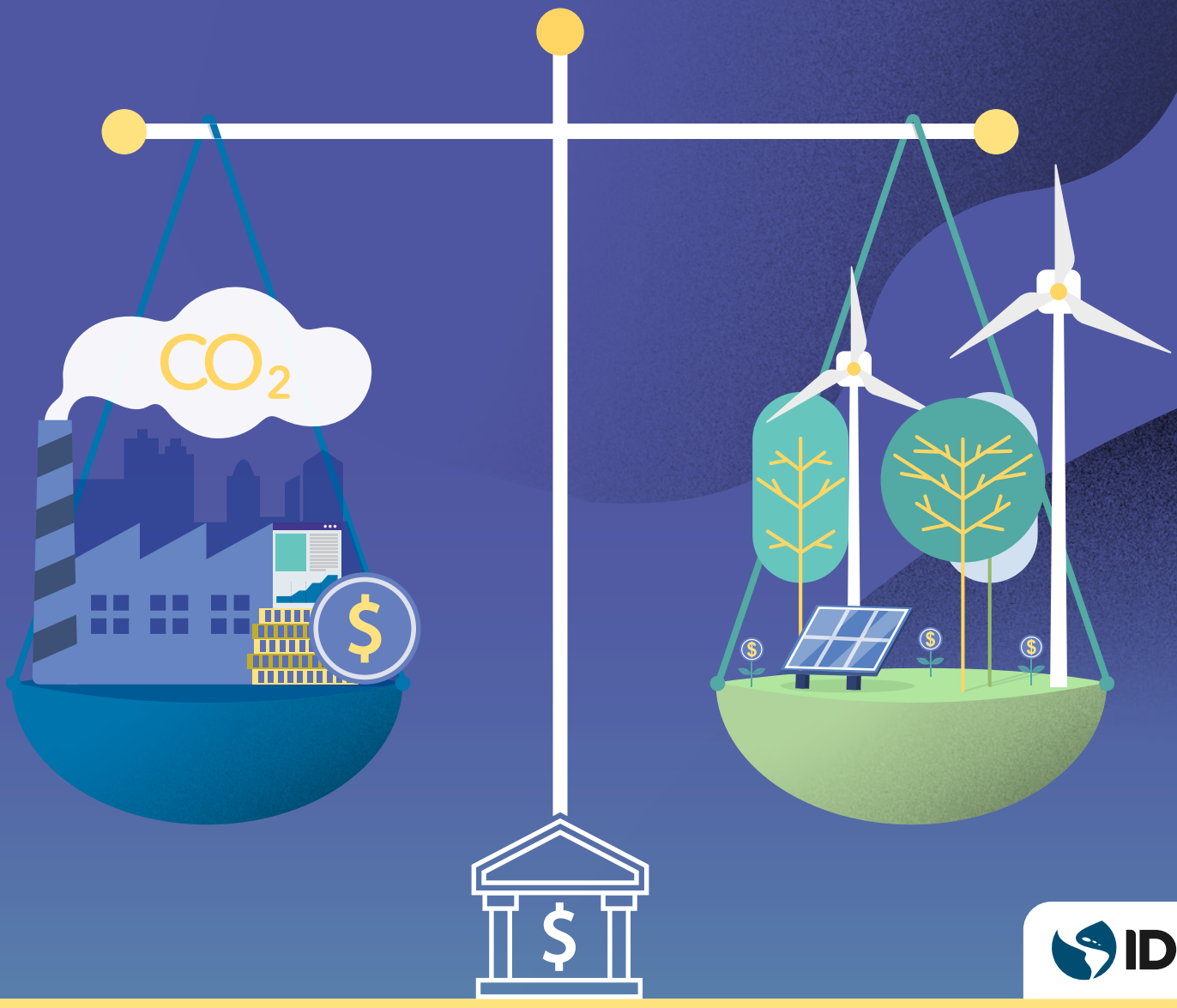
EXPECTATIONS OF ECONOMY AND FINANCE MINISTRIES ON CARBON PRICING AND EVIDENCE OF THEIR EFFECTIVENESS

REGIONAL **CLIMATE CHANGE** PLATFORM | ECONOMY AND FINANCE MINISTRIES



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1 INTRODUCTION

1. Introduction

1.1 Background and Objectives

Latin America and the Caribbean (LAC) countries signed the Paris Agreement, which aims to increase adaptation to climate change and stabilize global warming to below 2°C, and as close as possible to 1.5°C, with respect to pre-industrial levels. This requires reaching zero net greenhouse gas (GHG) emissions by 2050 (IDB and DDPLAC, 2019). Achieving decarbonization requires far-reaching and unprecedented action at the global level across all sectors, such as power generation, transportation, construction, and agriculture (Fazekas, Bataille, and Vogt-Schilb, 2022), which poses challenges and opportunities for fiscal sustainability and the work of finance ministries.

To meet this challenge, action by Ministers of Finance and Economy is fundamental. The Regional Climate Change Platform of Economy and Finance Ministries of Latin America and the Caribbean provides the opportunity to share knowledge and draw up policies for addressing the consequences of climate change; the end goal is to monitor progress and needs for climate change to be incorporated into the fiscal policy of LAC governments.

Different working groups were set up within the Platform; One such group addresses issues surrounding revenue and fiscal incentives that can help combat climate change; the objective is to better discern the limitations and barriers of the various carbon pricing instruments to achieving carbon neutrality, and build resilience in the LAC region.

During the design and launch of the Platform, consultations were held with each of the countries on their progress and needs for incorporating climate change into fiscal policy. Concerning carbon pricing, it was found generally that there is an incipient understanding of what is to be expected (limitations and benefits) from instruments such as carbon markets and taxes in terms of contributing to, or affecting the achievement of, climate goals and how they should be designed in order to reach those goals. This paper studies the expectations and objectives of these ministries in implementing carbon pricing mechanisms, and reviews the empirical evidence on how these instruments can meet those expectations. To this end, the following exercises were carried out:

Interviews: Semi-structured qualitative interviews were conducted with finance ministries of the LAC region to collect information on carbon pricing instruments already implemented or under consideration, together with expectations, results, and any other relevant findings.

Systematization of results: Common responses were found throughout the content of interviews. Notwithstanding, the systematization process for the results was exhaustive in also recording the differences between all types of expectations.

Critical review of empirical evidence: The expectations and objectives pronounced in the interviews are compared to the empirical evidence, in this case, the literature on the theoretical justification for carbon markets and the evolution and trends of carbon pricing mechanisms. All of this is compared with what has been delivered in practice, regarding emission reductions, boosting innovation, and adoption of green technologies. The results of the interviews are also checked against Article 6 of the Paris Agreement, and the regulation on voluntary cooperation between parties to agree to transfer reductions between countries.

1.2 Carbon Pricing Definition

Carbon pricing instruments are economic policies for promoting the reduction of greenhouse gas emissions resulting from the use and consumption of fossil fuels and their derivatives, by internalizing the cost of their emission. The theory is to create conditions for actors, such as companies or automobile users, to internalize the costs they generate for society through the pollution caused by their activity (Pigou, 1932). In this sense, carbon pricing incentivizes reduction, and potentially elimination, of emissions by encouraging adoption of consumption and production alternatives where the cost per ton avoided is lower than the price imposed (Haites et al., 2023). It is important to note that the amount of the tax is decisive; when the cost of reducing emissions is higher than the price imposed, it is more convenient to pay the tax than to reduce emissions. Because they incentivize the cheapest emission reduction options, carbon prices have been described as an economically efficient or "cost-effective" mechanism (Nordhaus, 1992; Goulder and Shein, 2013; Haites et al., 2023).

Of the variety of carbon pricing instruments that exist, this analysis focuses on the three most common: carbon taxes (also called green taxes); emissions trading systems; and emissions credit markets. The term "carbon market" can refer to both emission allowance and emission credit markets. Other fiscal and economic instruments which can create incentives to reduce or increase greenhouse gas emissions –though not covered in detail in this document- include subsidies, taxes on fuels not defined by their emissions content, or taxes on cars based their cylinder capacity. For more information on the relationship of these instruments to carbon pricing, see Ahumada et al. (2023).

First, **carbon taxes** seek to tax greenhouse gas emissions by imposing a fixed cost per emission unit, for example, per ton of CO_2 equivalent. These taxes can be applied to mobile sources, taxing on proxy emissions, such as fuels based on their carbon content; or on stationary sources, where emissions are measured, in specific sectors such as the aluminum, steel, or cement industries.

Emissions trading systems, on the other hand, fix a maximum volume of emissions permissible by distributing emission allowances. Allowances can be distributed in various ways; for example, they can be allocated free of cost directly to economic actors or sold through auctions. These allowances are tradable, whereby holders with cheap abatement alternatives can sell them to those facing higher mitigation costs. The free purchase and sale of allowances would generate an equilibrium "carbon" price.

Carbon credit markets enable companies to invest in projects for reducing emissions and then sell those reductions in the form of carbon credits, while enabling other companies to offset their emissions by buying them. Unlike emissions trading systems where emission rights are the tradable asset, in the case of credit markets, the tradable asset is carbon reduction or sequestration certificates. Carbon credits can be certificates of emission reductions or removals. Emission reduction projects include, for example, replacing lighting fixtures with LEDs, conserving forests in areas of high deforestation, or bringing forward closure of a thermoelectric plant. Credits for removals include reforestation projects for capturing carbon already emitted. The quality of carbon capture or reduction certificates depends on factors such as prevention of double counting, prevention of carbon leakage, ensuring the permanence of removals,

Carbon credits can be certificates of emission reductions or removals. Emission reduction projects include, for example, replacing lighting fixtures with LEDs, conserving forests in areas of high deforestation, or bringing forward closure of a thermoelectric plant. Credits for removals include reforestation projects for capturing carbon already emitted. The quality of carbon capture or reduction certificates depends on factors such as prevention of double counting, prevention of carbon leakage, ensuring the permanence of removals, verifiability, transparency, and financial additionality, where projects must show that their objectives would not have been met without the additional resources from the sale of the carbon credits of the project (OICU-IOSCO, 2022).

Furthermore, emission credit markets can be domestic, where credits must be purchased domestically, or international. The transfer of emission reductions between member countries of the Paris Agreement can fit into the framework of Article 6, which enables voluntary cooperation between parties subscribed to the agreement, for the purpose of transferring reductions between countries. This means that a country can transfer carbon credits obtained from its emission reductions to help one or more other countries meet their climate targets (United Nations, 2015; World Bank, 2023a). An issue

central to Article 6 is the prevention of double counting reductions, which requires corresponding adjustments between the transferring party and the receiving party; a country that sells credits internationally needs to deduct those emission reductions from its nationally determined contributions (NDCs), that is, the sale of carbon credits is recorded as an increase in emissions in the selling country, and a reduction in the buying country.

Carbon taxes, emissions trading systems, and carbon credit markets are not substitutes but they can complement each other. In countries with a carbon credit market and a carbon tax, it is common to allow offsetting of the tax by demonstrating that emissions have been reduced or eliminated through carbon credits. Companies can also do this voluntarily through organizations which develop projects which reduce emissions, such as forest restoration.

Since its implementation under the Kyoto Protocol, carbon pricing has gained some popularity as an environmental instrument, and is promoted by many countries and international agencies. To date, 73 carbon pricing initiatives have been implemented globally, covering approximately 12 gigatonnes of CO2eq equivalent, representing 23 percent of global greenhouse gas emissions (World Bank, 2023b). Five countries in LAC have already implemented carbon pricing -Argentina, Chile, Colombia, Mexico, and Uruguay- covering 17 percent of regional emissions (see Table 1). All five countries deploy carbon taxes, with Chile, Colombia, and Mexico including offset systems via carbon credit markets. Uruguay's carbon tax was not designed to be offset with carbon credits. Mexico is currently introducing a pilot scheme for a tradable emissions trading system (World Bank, 2023b).

The price level in the region tends to be relatively low. Argentina, Chile, and Colombia have a carbon price of $5 usd/$tCO_2$. Mexico, meanwhile, has a carbon price of between US$0.04/$tCO_2$ to US$4/$tCO_2$. Uruguay, as the exception, has the highest carbon price in the world at US$156/$tCO_2$, arriving at this value by redefining existing taxes on fossil fuels based on their emissions. Table 1 summarizes carbon prices implemented at the regional level (World Bank, 2023b). In contrast, the European Union's tradable emissions system, (EU-ETS) has a carbon price which exceeded US$100/$tCO_2$ in 2023. Lichstenstein, Sweden, and Switzerland have national carbon prices exceeding $120/$tCO_2$ (World Bank, 2023a). The World Bank estimates that a carbon price consistent with decarbonization targets should be between US$61 and US$122/tCO_2 by 2023 (World Bank, 2023a). If one also considers other existing taxes and subsidies that indirectly impact activities which emit greenhouse gases, Ahumada et al. (2023) find that the LAC region has a relatively low effective carbon price, that is, a net tax on emissions of US$18/$tCO_2$, which is much lower than the OECD average of approximately US$43/$tCO_2$.

Table 1. *Carbon Taxes Implemented in the LAC Region for 2023*

Country	Price (USD)	Coverage	Percent of emissions covered	Implementation start year	Estimated collection 2023 (MUSD)
Argentina	**US$** 3/$tCO_2$	Liquid fuels, coal, and petroleum coke. Exceptions exist in some sectors and activities.	20%	2018	$167
Chile	**USD$** 5/$tCO_2$	Establishments that emit emissions from stationary sources (see box 2).	29.4%	2017	$171
Colombia	**USD$** 5/$tCO_2$	All liquid and gaseous fuels, with some exeptions (see box 3).	23%	2017	$92
Mexico (tax)	**USD$** 4/$tCO_2$ (kerosene) **USD$** 0.41/$tCO_2$ (oil)	Fossil fuels are taxed except natural gas. Only the difference in emissions related to natural gas is taxed.	44%	2014	$239
Uruguay	**USD$** 156/$tCO_2$	Taxes emissions from gasoline combustion.	11.2%	2022	$271

Source: World Bank, 2023b.

Note: Colombia and Mexico have emissions compensation systems in place, while Chile is in the process of developing its own compensation system.

Compliance with the Paris Agreement requires the elimination of carbon emissions from countries' energy systems by 2050 (IDB and DDPLAC, 2019). Achieving decarbonization requires far-reaching global action across all sectors, such as power generation, transportation, construction, and agriculture (Fazekas, Bataille, and Vogt-Schilb, 2022). It implies not only transitioning to net-zero emission technologies but also ceasing to invest in so-called low-carbon technologies; for example, moving from coal-based power generation to natural gas-based power generation is nevertheless still an investment in fossil fuels. Low-emission technologies can replace more carbon-intensive assets in the short term, but their effect is short-lived, since they do not eliminate carbon emissions and are therefore inconsistent with the Paris Agreement (Vogt-Schilb, Hallegatte, and de Gouvello, 2014, Patt, Lilliestam, and Pfenniger, 2019b). Therefore, the rationale of this study is to analyze carbon pricing mechanisms, not from the point of view of whether they reduce emissions, but whether or not there is evidence that they have encouraged changes towards investments consistent with decarbonization.

The study's findings tally with the empirical evidence in existing literature in showing that the carbon prices instruments used to date have indeed generated emissions reductions, although these alone are insufficient for meeting the goals of the Paris Agreement (Green, 2021b; Van der Bergh and Savin, 2021). Moreover, they have primarily been able to incentivize operational changes (such as using existing natural gas power plants more than coal-fired ones) but these have been insufficient for incentivizing transformative investments consistent with a net emissions transition (for example, investment in renewables) (Lilliestam, Patt and Bersalli, 2021).

The difficulty in implementing higher-value carbon prices, together with the lack of more extensive coverage across sectors and countries, undoubtedly constitutes a major barrier to the effectiveness of carbon pricing (Jenkins, 2014; Rozenberg, Vogt-Schilb, and Hallegatte, 2020). However, there are many other barriers to the adoption of clean technologies and a transition to a net-zero emissions economy in countries (Fazekas, Bataille and Vogt-Schilb, 2022); carbon pricing instruments alone are unable to remove such obstacles, particularly in sectors which are difficult to decarbonize (Heal and Schlenker, 2019, Rosenbloom et al., 2020). These barriers include regulatory barriers, the lack of available infrastructure, a lack of information, and insufficient capacity. With key technologies such as renewable energy and electromobility becoming more affordable compared to fossil fuel-dependent alternatives, it is unclear what priority governments should give to carbon pricing.

If carbon pricing is not correctly understood it risks distracting the climate policy discussion from the essentials of meeting NDC commitments and achieving carbon neutrality by 2050. Indeed, climate change mitigation should be treated as a problem related to the structural transformation of society rather than as a market failure (Green, 2021a). Climate policy must always consider what is needed to manage a transition to carbon neutrality, which usually requires a broad set of actions rather than solely exploiting marginal emissions reductions with the cheapest marginal abatement costs (Fay et al, 2015).

2

INTERVIEW RESULTS

2. Interview Results

2.1 Methodology

Interviews were conducted with 12 ministries of finance: Argentina, Bahamas, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Honduras, Mexico, Paraguay, Peru and Uruguay. Those selected were participants in Working Group 2 of the Platform of Ministries, or from other interested ministries.

The semi-structured interviews sought to identify five key elements: (i) what carbon prices exist or are being considered, (ii) the objectives or expectations in implementing such mechanisms or reviewing existing mechanisms, (iii) how the revenues from such instruments are or will be managed fiscally, (iv) barriers to the implementation of carbon prices or the measures needed to make them effective, and (v) whether evaluations have been carried out.

Results of the interviews are presented below, first detailing the design characteristics, including types of instruments, expectations and objectives of implementing them, and the barriers which prevent implementation or achieving expected results; and second, describing the institutional difficulties currently faced by the region's finance and economy ministries in implementing carbon pricing. Annex 1 presents summary tables of the results.

2.2 Expectations and Objectives of the Ministries Interviewed

Carbon pricing in the region has had a primarily environmental objective. In 8 of the 12 countries, interviewees stated explicitly that establishing carbon prices had the principal and specific goal of contributing to environmental policy, using economic instruments. In the other countries interviewed, though not stated explicitly, carbon pricing is seen to be directly or indirectly related to environmental policy to incentivize reductions or finance other environmental policies. Box 1 summarizes the main findings.

LAC countries have not evaluated existing carbon taxes' effectiveness in providing incentives to reduce emissions. Although the countries state that their main objective is to encourage behaviors which reduce emissions, such as reducing polluting activities and adopting cleaner technologies, it should be noted that the countries that have implemented this type of instrument have not yet evaluated whether these objectives have been met. Interviewees are inclined to think they have not achieved the expected results.

Some countries use carbon pricing to raise additional revenue. While the primary objective is environmental, five ministries also highlight the possibility that a portion of the revenues raised by carbon pricing mechanisms can be allocated to public spending on climate action. However, three ministries mentioned that a permanent spending commitment that is dependent on a tax revenue is considered bad practice in public financing. Periodic expenditures must be financed through the general budget and not be financed through specially designated funding sources. However, it is recognized that this can be done on a transitory basis and that, furthermore, it has the added benefit of improving society's perception of establishing such a tax. On the other hand, one of the ministries interviewed that maintains a specific allocation criterion, emphasizes that the resources collected via this type of instrument may be insufficient if directly allocated.

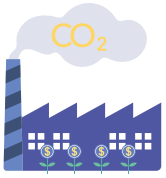
Some countries use carbon pricing to mobilize private resources. The role of carbon credit markets in channeling resources to finance projects that reduce emissions or sequester carbon, such as reforestation or changing lighting fixtures to LEDs, is highlighted. Four of the ministries interviewed saw this objective as necessary for their carbon credit markets, where actors seeking to offset their emissions will finance projects aligned with the environmental agenda.

One country aims for its carbon tax to have a neutral fiscal impact. Of the five countries in the region with a carbon tax already in place, Uruguay's carbon tax was the only one designed to avoid an additional fiscal burden on taxpayers. Since 2022, Uruguay has had a formal carbon tax of US$156/tCO$_2$, the highest globally. The amount was justified by making explicit the tax burden that already exists for gasoline based on emissions. This modification aims to establish the CO$_2$ content as a variable for designing taxes.

Carbon taxes and credit markets are the main instruments considered in the region: Several ministries highlighted that they have already implemented carbon pricing. These ministries and other ministries which do not yet have mechanisms in place, expressed interest in developing more mechanisms in their respective countries, or improving existing ones.[1]

Taxes: There is interest in carbon taxes; seven of the ministries interviewed have already implemented some form of carbon tax, or are currently analyzing implementation: Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, and Uruguay. The most commonly considered tax is tax on mobile sources, that is, gasoline and diesel. Six countries already have fuel taxes or are interested in introducing them. However, taxes on stationary sources are also mentioned by one country.

Credit markets: Six ministries express interest in further embedding, or developing these instruments: Argentina, Brazil, Chile, Colombia, Dominican Republic, Honduras, and Mexico,. On one hand, three countries have, or are developing, domestic carbon tax offset systems, while three other countries are interested in developing credit markets in line with Article 6 of the Paris Agreement.

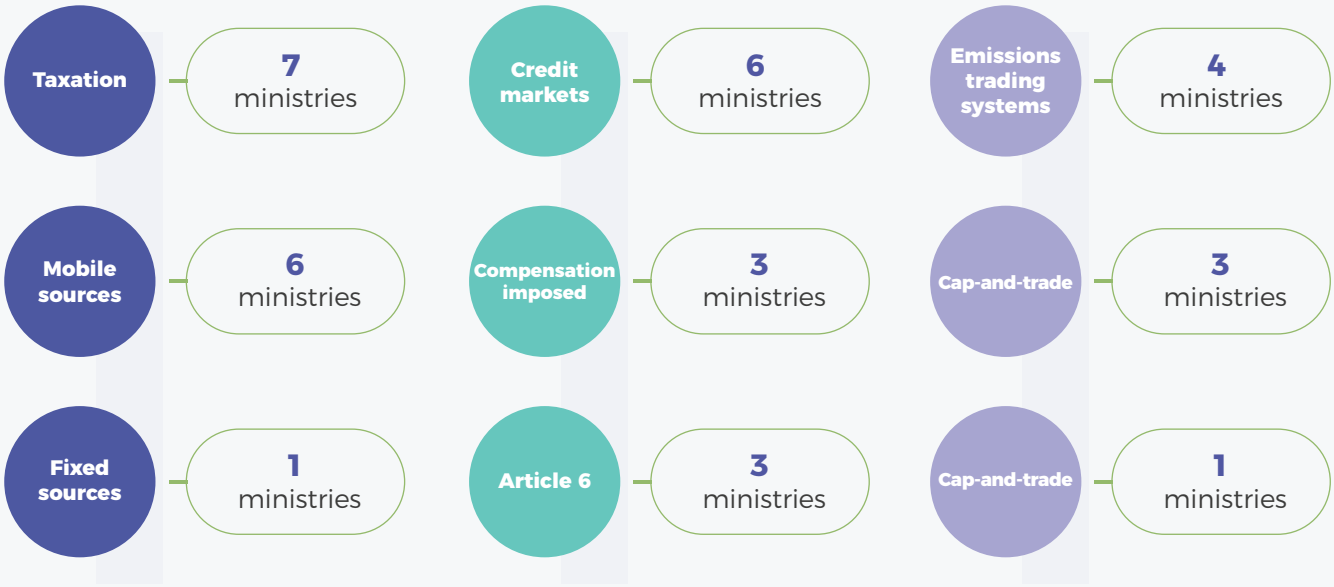


Emissions trading systems: Four countries are interested in exploring emissions trading systems: Bahamas, Brazil, Chile, and Colombia.

1 The analysis considers countries that have an instrument or are considering implementing one. In the case of countries analyzing the implementation of an instrument, some are already in the implementation study phase and others mention that, though analyzing it, they do not intend to implement the instrument in the short term.

Box 1. Main Instruments Considered and Expectations

Main instruments*



Main objective of implementing carbon pricing:

Establishing carbon pricing in the region has a mainly environmental objective for all the ministries interviewed, where it seeks to directly or indirectly support environmental policy.

Environmental objectives*

7 ministries seek to **incentivize** emissions reduction

5 ministries seek to **raise** additional revenues for environmental policy

4 ministries seek to **mobilize** private funding

* Countries interviewed may have more than 1 of the 3 environmental objectives.

In the region, there are also instruments similar to carbon pricing that are not defined in terms of emissions. Five ministries highlighted that they have instruments similar to carbon pricing, or that meet similar objectives, and that these enhance the efforts to support environmental policy: taxes on fuels not defined in terms of carbon emissions; and charges on the first purchase of vehicles based on their fuel efficiency or cylinder capacity. In general, these instruments pre-date carbon pricing.

2.3 Main Challenges

The distributional impact of carbon pricing presents a challenge to setting high prices. Ministries interviewed highlighted the barriers they face to setting carbon taxes at levels that could significantly affect consumption and investment patterns. Three countries explicitly underline the difficulty in implementing high prices or raising existing prices. Four other ministries note that they are constrained from raising or creating new taxes, either because the overall taxes in the country are already high, or because of an unfavorable economic contingency. The difficulty in raising taxes or establishing carbon pricing is related to the social and economic impacts that such introduction or extension could have. Specific sectors such as industrialists, transporters, and low-income families would suffer impacts difficult to absorb. In this sense, introducing carbon prices or raising existing ones could have impacts on meeting national objectives of just transition; however, it is also widely recognized that carbon taxes with a low rate prevent these instruments from achieving their corrective objective.

An unintended effect of carbon pricing is carbon leakage. One ministry noted that positive results of high prices are expected in some industries, while in others, reductions would only account for national (but not global) reductions, if relocating their activities to another jurisdiction. In the same vein, differentiating the carbon price by industry would make it difficult to generate carbon prices that could lead to emission reductions in all sectors.

Low carbon prices hinder the effectiveness of credit markets. Establishing carbon credit markets are of interest due to their contribution to mobilizing resources for projects that capture or reduce emissions. However, one ministry noted that low prices significantly reduce the number of cost-effective offset projects, thereby restricting this market.

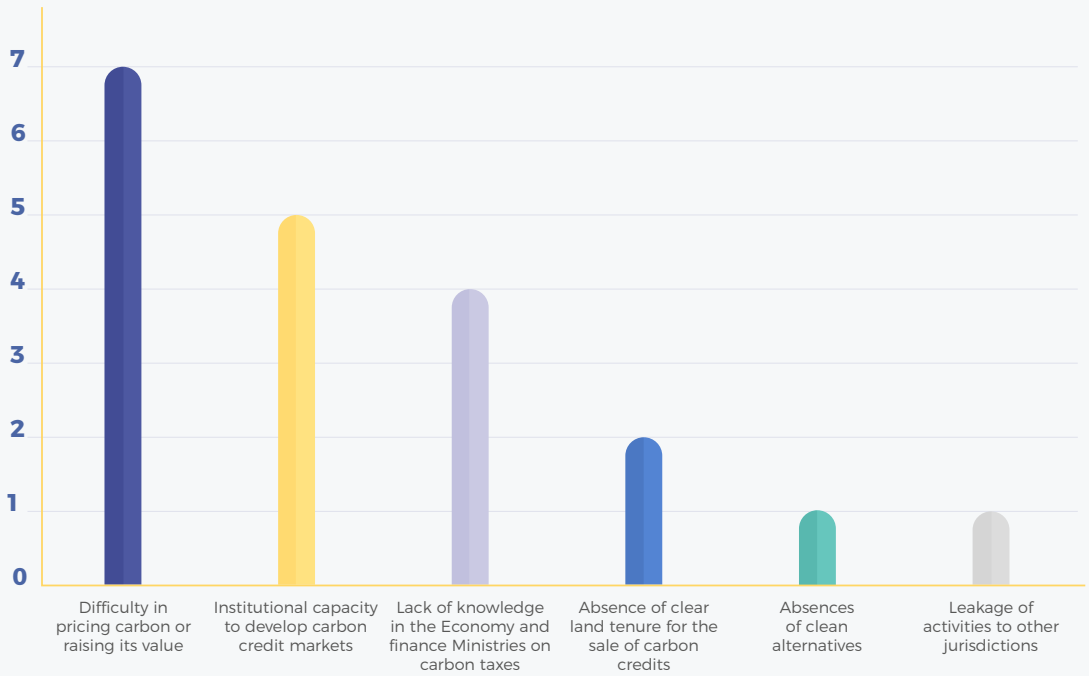
There are institutional difficulties in creating carbon credit markets in the region's countries. Five of the eight ministries interested in implementing a carbon credit market highlight that the main barriers are institutional, hindering governments' ability to implement the desired instruments. Institutional barriers include: insufficient technical knowledge of officials, errors in information, and lack of capacity (relatively small teams). Three of the ministries interviewed which are in the early stages of developing, or intending to develop, these instruments, highlight the lack of institutional capacity for establishing credit markets. The gaps include regulatory requirements, definition of institutional roles, development of guidelines, methodologies, and baselines. Several ministries highlight lack of information in certain sectors as one of the major barriers to implementing credit markets, and two ministries from countries with more developed carbon credit markets highlighted the lack of capacity to verify that projects meet additionality criteria.

Lack of land tenure is also a barrier to establishing carbon credit markets in some countries in the region. Ministries in two countries also highlighted that the lack of, or a weak, legal framework on land tenure is a barrier to the development of carbon markets. The lack of land tenure makes it difficult for forest conservation projects to issue credits in carbon markets.

In some cases, finance or economy ministries lack knowledge concerning carbon taxes. Four ministries highlighted lack of knowledge of this type of instrument and its impacts, as being a barrier to implementing carbon taxes. The figure rises to six ministries if other carbon pricing instruments are considered. Among the difficulties are: determining the distributive impact, fixing a price, deciding which industries will be affected, and what type of carbon tax to use. Furthermore, It is also necessary to know how to design instruments which not only reduce emissions at the margin, but change the type of investments and technologies used as well.

The absence of clean technology alternatives can be a barrier to the effectiveness of carbon pricing in the region; there are specific barriers to adopting cleaner alternatives and these prevent carbon taxes from being effective as a corrective instrument; for example, the absence of public transport, sidewalks, or bicycle lanes makes it difficult for private transport users to seek alternatives.

Figure 1: *Summary of Main Barriers Identified by Ministries Interviewed*



There is a need to strengthen state institutions to implement carbon pricing instruments. There is a need for technical teams that can: (i) evaluate the effectiveness of carbon pricing instruments, (ii) establish communications with sectoral ministries to align with long-term decarbonization strategies and/or NDCs; (iii) design instruments that consider the distributional impacts of carbon pricing; (iv) implement monitoring, reporting and verification systems; and (v) identify barriers to the implementation of clean technologies.

3

ANALYSIS RESULTS AND CONTRAST WITH THE LITERATURE

3. Analysis Results and Contrast with the Literature

In general, the ministries interviewed highlight carbon pricing as an instrument which they wish to implement; however, they recognize that, given the conditions for implementation, its effectiveness in meeting its main objective of encouraging a change in behavior and investment patterns, will be limited; therefore, expectations are moderate. These expectations are then contrasted with existing literature on studies that analyze the diverse evidence of the effectiveness of carbon pricing instruments (see Table 2). Case studies regarding barriers to implementing effective carbon pricing as well as to necessary transformations in the economy consistent with emissions neutrality are also analyzed.

Table 2: *Summary of Studies Analyzing Evidence of Carbon Pricing*

Green (2021b)	An ex-post analysis of 37 quantitative evaluations of carbon pricing policies worldwide is performed.	The aggregate reduction in emissions resulting from carbon pricing is generally 0 to 2 percent per year. In addition, a high variability in the effectiveness of emission reductions between sectors was found. Finally, carbon pricing has been more effective than emissions trading systems.
Lilliestam, Patt, and Bersalli (2021)	Performs an ex-post analysis of academic studies evaluating the effectiveness of existing carbon pricing instruments in British Colombia, the European Union, New Zealand, and the Nordic countries.	The ex-post studies evaluated found a positive impact of carbon pricing in promoting operational changes. However, no evidence is found that carbon pricing has contributed to promoting the adoption of zero-emission technologies.
Van der Bergh and Savin (2021)	Evaluate the empirical evidence on the effectiveness of carbon pricing in response to Lilliestam, Patt, and Bersalli. (2021).	Carbon pricing has had a small but positive impact on promoting zero-emission technologies. Among their conclusions, the authors point out that technological transformations require long periods of time, affecting the results of the current empirical evidence.
Köppl and Schratzenstaller (2022)	The authors evaluate 19 existing ex-post studies measuring the impact of carbon taxes on: emissions reductions, macroeconomic impacts, impacts on competitiveness and innovation, and distributional impacts.	The studies analyzed find that carbon taxes have contributed to reducing emissions or reducing their growth without affecting economic growth or competitiveness.
Tvinnereim and Mehling (2018)	Analysis of the existing literature on the contribution of carbon pricing in reducing emissions, identifying the limits to its price and coverage.	It concludes that the carbon pricing instruments studied have been successful in incentivizing emissions reductions. However, these effects are insufficient for reaching the objectives proposed in the Paris Agreement. In turn, existing carbon price schemes have not proven effective in incentivizing the adoption of clean technologies and behavioral changes. These instruments may be more effective in specific sectors, or as revenue-generators.
Haites et al. (2023)	Discussion of the existing literature on the effectiveness of carbon pricing in reducing emissions, its effectiveness in promoting innovation, its distributional impacts, and how it can be used to achieve net zero emissions targets by 2050. It explores implementing carbon pricing within a public policy package to minimize the risk of leakage of polluting activities to other jurisdictions.	It argues that carbon pricing instruments can be a useful component of a public policy package to minimize the risk of adverse economic impacts. In addition, carbon pricing instruments generate revenues that can be used to reduce their distributional impacts and improve their acceptability. Finally, implementing carbon pricing within a public policy package minimizes the risk of leakage of polluting activities to other jurisdictions.
Heal and Schlenker (2019)	A cost estimate at the oil and natural gas field level to identify the impact of the global carbon tax.	A carbon price of US$200/$tCO_2$ would generate a 4 percent reduction. This is mainly due to the shutdown of high-cost oil and gas extraction operations. Fossil fuel fields affected by lower carbon prices would only delay production.

3.1 Carbon Pricing and Net Zero Emissions Targets

Several of the ministries interviewed expect carbon pricing to have a corrective purpose. Overall, estimates of the effectiveness of carbon pricing in reducing greenhouse gas emissions have been positive (Köppl and Schratzenstaller, 2022), but are not substantial relative to current carbon neutrality targets (Haites, 2018; Tvinnereim and Mehling, 2018). A recent meta-analysis of 37 ex-post studies identifies that implemented carbon price schemes have generated total reductions of 0 to 2 percent per year. However, these values may be higher when focused on specific sectors (Green, 2021b).

Reductions can be aggregated over time and account for more significant impacts, though these are not sufficient to meet decarbonization targets. For example, in Finland, a study used synthetic[2] controls to find the effects of 31 percent in emission reductions relative to a baseline scenario, between 1990 and 2005 (Mideska, 2021).

There are also carbon pricing impact studies that find higher emission reductions. However, in many cases, these can be contradictory. For example, Fernando (2017) uses an estimate of synthetic controls and finds annual reductions of 17.2 percent in Sweden and 19.42 percent in Norway, while reductions in Denmark and Finland are not statistically significant. In contrast, Lin and Li (2011) found that carbon taxes in Norway, Sweden and Denmark had no effect on emission reductions, and in the case of Finland the effect is weak, with about 1.69 percent in per capita reductions.

The evidence of positive effects focuses on countries with higher taxes than those considered in the LAC region. For example, one of the most robust studies finds that in Sweden the carbon tax, starting at US$30/tCO$_2$ in 1990 and reaching US$109/tCO$_2$ in 2004, reduced emissions from the transport sector by 6.3 percent in that period, compared with a baseline scenario (Andersson, 2019). For Europe, it is estimated that implementing a tax of US$40/tCO$_2$, covering 30 percent of emissions would lead to an emissions reduction of between 4 and 6 percent over six years (Metcalf and Stock, 2020). In Canada, the tax implemented in British Columbia started at CA$10/tCO$_2$ (approximately $7usd) in 2008, rising annually by CA$5 until reaching CA$50/tCO$_2$ (approximately US$37) in 2022 (Haites et al., 2023). A recent study finds no statistical impact of the tax or the tradable emissions system on aggregate emissions reductions (Pretis, 2022; Haites et al., 2023). In a more extreme case, an estimate of the impact of a global carbon price on oil and natural gas field production finds that a price of US$200/tCO$_2$ would generate reductions of 4 percent (Heal et al., 2019).

In contrast, the carbon prices proposed in the region are lower than US$10/tCO$_2$.[3] Some of the countries interviewed aspire to increase prices to values closer to US$50/tCO$_2$, although they emphasize that such an increase is not currently possible.

2 Synthetic controls are a method of statistical estimation and causal inference to evaluate the effect of an intervention in cases where there is no control unit. This methodology proposes the creation a "synthetic" control group based on existing information that seeks to replicate the characteristics of the treated unit prior to the intervention. For more information on this methodology, see Abadie (2021).

3 Argentina, Chile, and Colombia have a carbon price of $5/tCO$_2$. Mexico's is between $0.4/tCO$_2$ and $3.7/tCO$_2$ and Uruguay's $156/tCO$_2$ which, as mentioned above, is the result of redefining existing taxes on fossil fuels in relation to their emissions (World Bank, 2023a).

3.2 Barriers to the Effectiveness of Carbon Pricing

According to the interviews conducted for this study, there is a strong interest in using carbon pricing to support environmental policy, or to help meet international commitments. Considering the relationship between carbon prices and the quality of the emission reductions derived from them, is therefore fundamental. However, empirical evidence shows that, at their current levels, carbon prices implemented to date have mainly incentivized operational changes that require marginal technological adjustments, such as using existing gas-fired plants instead of existing coal-fired plants. In the same way, there is little evidence of the impact of carbon pricing instruments implemented to date on the adoption of low-carbon technologies, or those consistent with achieving net-zero emissions, such as deploying solar or eolic electricity (Lillesta, Patt, and Bersalli, 2021; Tvinnereim and Mehling, 2018). At best, there is a positive, but minor impact (Van der Bergh and Savin, 2021). Installing carbon prices with a corrective purpose should not only consider the "quantity" of reductions but also the "quality" of those reductions, which depends on implementing changes that lead to net zero emissions in the medium term.

Undoubtedly, the difficulty in implementing higher-value carbon prices and the lack of a more extensive coverage, constitute a major barrier to the effectiveness of carbon prices (Jenkins, 2014; Rozenberg, Vogt-Schilb, and Hallegatte, 2020). However, there are other factors unrelated to price. Multiple options for technologies and behavioral changes which align with the Paris Agreement's climate objectives have been identified. These changes, though technologically feasible and cost-efficient in many cases (IPCC, 2022), are not necessarily materializing. Many barriers prevent the adoption of such solutions (Fazekas, Bataille, and Vogt-Schilb, 2022), and carbon pricing instruments alone cannot suffice, particularly in sectors which are difficult to decarbonize (Heal and Schlenker, 2019, Rosenbloom et al., 2020).

In the energy sector, for example, renewable energies are already competitive for electricity generation; however, in many cases, they are not being implemented. Installing large-scale renewable infrastructure has high initial capital costs, even though its life-cycle costs are lower, thereby limiting access to financing for this type of project (Fazekas, Bataille, and Vogt-Schilb, 2022). At the same time, transmission and distribution infrastructure necessary for providing electricity to demand points such as homes and businesses, may be inadequate due to lack of storage systems or poor access to possible generation points (IEA, 2020). On the other hand, electricity generation regulations may favor large projects, making it challenging to install small-scale, more decentralized renewable projects, such as solar panels on the roofs of buildings or homes.

More generally, the lack of adequate infrastructure, the absence of regulations that favor green technologies, a lack of information, or insufficient capacity and human capital, are among the examples of institutional and market failures to be addressed beyond establishing a carbon price (Fazekas, Bataille, and Vogt-Schilb, 2022). Moreover, existing "installed" capacity in carbon-intensive infrastructure and technology can block emissions reductions. The existence of trained personnel and infrastructure with economies of scale in polluting activities, puts new activities at a competitive disadvantage, as they need to build their capacities (Lillestam, Patt, and Bersalli, 2021; Unruh, 2000).

The barriers to clean technology adoption and behavioral change could mean that changing the relative price through carbon pricing instruments has a reduced impact. For example, in British Columbia, Canada, a fuel tax impacted positively and significantly in reducing emissions in Vancouver, the state's main city, but its effect is weakened in more rural areas where alternatives to vehicle use are scarcer (Lawley and Thivierge, 2018).

The size and urgency of the emissions reductions needed, the difficulty of implementing high prices, and the multiple sectoral barriers, imply that relying solely on carbon pricing instruments may be insufficient, or even delay, the implementation of measures needed to achieve carbon neutrality (Haites et al., 2023, Fay et al., 2015). To achieve carbon neutrality by 2050 and stabilize the climate in line with the goals of the Paris Agreement, it is necessary to treat climate change mitigation as a problem of the re-structuring of society, and not solely as a market failure (Green, 2021a). Achieving net-zero emissions will require action and planning by businesses, households, and government agencies from different sectors of the economy.

3.3 Effectiveness of Carbon Pricing in Environmental Policies

One of the most common objectives among the ministries interviewed is for carbon pricing to support environmental policy, complementing other instruments to achieve carbon neutrality goals, or adjusting them for specific sectors. Evidence shows that including carbon pricing within a set of public policies has a more significant impact than carbon pricing alone (IPCC, 2022; Haites et al., 2023). Combining policies that incentivize the phase-out of carbon-intensive technologies with policies which support the adoption of clean technologies is an effective strategy for the transition to zero emissions (IPCC, 2022). For example, implementing an emissions trading system and, in parallel, designing state programs which financially support the adoption of clean technologies and provide technical training to professionals, can be an effective strategy to reduce emissions in the cement, aluminum, or chemical industries, where there is a risk that, in the face of rising costs, production will migrate to another jurisdiction (Haites et al., 2023). Indeed, the third meeting of G20 finance ministers and Central Bank governors stressed the importance of using a mix of public policies that consider fiscal, market, and regulatory instruments, including carbon pricing if deemed appropriate (G20, 2023).

It must be remembered that reducing emissions requires a capital investment with long lifetimes. One study analyzing decarbonization strategies argues that starting with large investments, and not necessarily those with the lowest abatement cost, is optimal, therefore using carbon prices alone does not necessarily align with this strategy (Vogt-Schilb, Meunier, and Hallegatte, 2018). In this sense, a set of policies implemented at the sectoral scale is required, focused on overcoming the obstacles to making such investments, and in this case, carbon prices can play a complementary role in supporting such policies.

Findings from the literature show that the carbon pricing instruments implemented to date had a greater impact on emissions reductions in specific sectors (Green, 2021b). Indeed, carbon pricing may be a more effective policy for promoting decarbonization from a sectoral perspective (Cullenward and Victor, 2020). For example, in France, implementing the European Union's tradable emissions trading system promoted reductions of between 15 and 20 percent in the regulated manufacturing sector (Wagner et al., 2014). In British Columbia, Canada, a study finds no significant impacts of a carbon tax at the aggregate level, but significant impacts in the transportation sector (Pretis, 2022). Carbon pricing can support emission reductions in sectors that are difficult to cover with other instruments (Tvinnereim and Mehling, 2018). On the other hand, Haites et al., (2023) highlight how a public policy mix that includes carbon pricing can have a strong impact in such sectors as cement, chemical, or aluminum industries.

Lin and Li (2011) conclude that three key factors affect the impact of a carbon tax: (i) the existence of tax exemptions or allowances in energy-intensive industries, (ii) the existence of differentiated tax rates between sectors, and: (iii) the use made of the revenues, for example, whether they are used for green investments, or for research and development.

3.4 Distributional Impacts as a Barrier to Reaching High Prices

A recurring theme highlighted during the interviews is the difficulty in implementing sufficiently high carbon prices. This is partly because carbon pricing is an unpopular instrument, where raising and setting prices high enough is complex. This is reiterated throughout the interviews, where some countries aspire to increase their carbon prices to values closer to US$50/ton, though they emphasize that such an increase is not currently possible. Considering these values, the corrective impact would be minor, even if carbon prices were to be raised.

While the transition to an emissions-neutral economy brings net benefits, it also implies that there will be winners and losers. It is important to ensure a just transition, mitigating harm to the most affected and distributing the benefits of decarbonization equitably (Alfonso et al., 2023). Carbon pricing generates costs for specific actors (Vogt-Schilb Meunier, and Hallegatte, 2018). Implementing carbon pricing has distributional impacts that cause strong public opposition, with numerous attempts at implementation repeatedly failing in their respective legislatures

(Carattini, Carvalho, and Fankhauser, 2018; Green, 2021a; Haites et al., 2023). In this regard, it is important to note that there is less opposition to implementing carbon pricing mechanisms if implemented gradually (Carattini, Carvalho, and Fankhauser, 2018).

An alternative to reduce distributional impacts, and in consequence to promote a just transition, is to use part of the tax revenue to offset the increase in price costs with actions such as cash transfers, benefit programs, or reduced taxes and tariffs. Chile's carbon tax mitigates the effects of the distributional impact; the tax is levied on emitting establishments, rather than directly on consumers, as is the case with fuel taxes. Additionally, the effect of the carbon price on the cost of energy is mitigated by not factoring it into the calculation of the instantaneous cost of energy—that is, the regulated price that functions as an indicator to define the cost of supplying energy from electricity generators to final consumers. Box 2 presents a detailed analysis of the case of Chile's carbon tax.

However, revenue neutrality also has its limitations. On the one hand, offsetting carbon pricing with reductions in other taxes does not improve its acceptability, highlighting the difficulty for the public in connecting a hike in an environmental tax with the reduction of other tax burdens (Carattini, Carvalho, and Fankhauser, 2018). On the other hand, using cash transfers and social programs could also prove an ineffective strategy to offset the distributional impact of carbon pricing. The impacts on carbon prices are heterogeneous across income groups, since factors such as vehicle ownership and cooking fuel are already present in all of them, although at different frequencies. An analysis of 16 Latin American countries shows that carbon pricing is a regressive instrument for 11 of them, impacting households in low income social groups. In turn, existing cash transfer programs may be imperfect. If used to offset the impacts of carbon prices, they may leave many of those most affected by carbon prices without access to these offsetting benefits (Missbach, Steckel, and Vogt-Schilb, 2023). At the same time, there are multiple other policies to mitigate distributive impacts, which follow the objective of ensuring a just transition, such as labor policies, sectoral policies, or industrial policies (Alfonso et al., 2023).

Box 2. *The Case of Chile: Carbon Pricing that Facilitates Implementation and Leads to Creation of an Infrastructure for Future Economic Instruments*

Chile has a tax on fixed sources that emit CO_2 levied since 2017. This is a "downstream" type instrument; that is, it is charged per emission, unlike instruments such as the fuel tax (García, 2018). It was created with a corrective purpose through Article 8 of Law No. 20,780, which also defines taxes on fixed sources for local pollutant emissions (NOx, PM and SO2) and on mobile sources, through a tax per cylinder capacity. Specifically, the law establishes an annual payment of US$5 per ton of CO_2 emitted, to establishments with one or more sources that emit over 25,000 tons of $C0_2$ per year.

The particular characteristics of the Chilean carbon tax stand out, since they succeed in overcoming the many barriers to implementing carbon pricing. Managing the distributional impact is fundamental to generating acceptance of carbon pricing instruments. By establishing taxes on fixed-source establishments, it bypasses charging a levy directly to the general public, as is the case for fuel taxes, thus minimizing negative reception of the levy. Additionally, this instrument considers measures to mitigate the impact on the financial viability of electricity produced by generators and, consequently, on the competitiveness of the electricity market and the end price of electricity. The law determines that the tax should not be considered for calculating the instantaneous, marginal cost of energy—that is, the regulated price that functions as an indicator to define the cost of supplying one more unit of product needed to meet the energy demand at a specific moment, thereby compensating those electricity generators that, as a result of the tax, must supply electricity at a higher cost than the sale price.

While it can be argued that these measures help reduce the instrument's impact and facilitate its implementation, they nonetheless diminish the instrument's effectiveness. First, not taking the tax into account for calculating the instantaneous cost prevents it from influencing the merit order of electricity generation, which defines the order in which power plants are activated to meet demand, based on the (rising) price of production. Second, compensating power generators whose production cost is higher than the instantaneous price due to the tax, reduces the economic incentive of the tax. However, after over five years since its implementation, and overcoming the initial barriers, and with the instrument now in use, the Chilean government has announced the elimination of compensation to generators (CNE, 2023).

Implementing this instrument has also served as a starting point for building the institutional infrastructure needed to identify and charge for emissions. Unlike taxes levied on fuels, taxes on stationary sources have the additional complexity of requiring the identification of emitting sources, measuring and verifying the volume of emissions, and charging the corresponding cost. In Chile, collecting this tax involves a combined effort between institutions, under the directive of both the Ministry of the Environment, and the Inland Revenue. First, the Ministry of the Environment identifies those establishments subject to the tax; these must register in the Pollutant Release and Transfer Registers System (PRTR) and report their emissions. For its part, the Superintendency of the Environment must regulate the methodological basis on which these establishments are obliged to calculate their emissions and establish a system for monitoring, reporting, and verifying them. The emissions reports are certified by the superintendence and sent annually to the Inland Revenue for the calculation of the tax, and thereafter collected by the Treasury (Pizarro, Pinto, and Ainzúa, 2020).

Finally, implementation of carbon pricing has brought financial benefits; In 2017, its first year of implementation, the total tax collected was US$168 million for CO_2 emissions (Garcia, 2018), projecting a collection for 2023 of US$171 million (World Bank, 2023b). Additionally, as of 2023, companies subject to the tax on fixed sources will be able to reduce their tax burden by offsetting their emissions. Emissions offsets will generate a carbon credit market projected to mobilize around US$100 million (CR2, 2021).

3.5 Carbon Pricing for Revenue Collection Purposes

In the absence of revenue neutrality, carbon pricing can also support climate policy through its revenue-raising potential, which aligns with the objectives of several of the ministries interviewed. For example, in 2022, applying carbon taxes and emissions trading systems generated global revenues of US$95 billion, of which $42 billion came from the EU-ETS (World Bank, 2023a). In addition, using carbon pricing instruments' resources for earmarking climate and environmental issues can help reduce public opposition to such instruments (Carattini, Carvalho, and Fankhauser, 2018).

The use of carbon pricing instruments for revenue collection has a certain degree of popularity, even though in some cases, taxes collected enter the general budget, and are not directly allocated to specific expenditures. In 2023, about 40 percent of global revenues from carbon taxes and emissions trading systems were earmarked for environmental issues (World Bank, 2023a). In Canada, the states of Alberta and British Columbia use earmarking strategies. In Alberta, US$97 million of the US$558 million obtained from its tradable emissions trading system is used to support carbon-intensive industries transitioning to clean technologies. British Columbia follows a mixed strategy where revenues from its carbon tax are allocated to manage the distributional impact on businesses and households and fund environmental action through a government program (World Bank, 2023a).

In the LAC region, Colombia's carbon tax stands out. Designed originally to generate incentives for the transition, it has also been able to finance climate action. With a tax on fossil fuels of almost $5 usd/$tCO_2$, this tax has generated significant revenues for Colombia, reaching over US$100 million by 2022. This revenue represents around 0.1 percent of the government budget for that year, but exceeds the Ministry of Environment's budget of several previous years. Furthermore, this tax revenue is specifically designated; 80 percent to the Sustainability and Climate Resilience Fund, and 20 percent to the Colombia in Peace Fund. Box 3 presents a detailed analysis of the case of Colombia's carbon tax.

Finally, it must be noted that using carbon pricing for direct financing has its difficulties. It is necessary to analyze the effectiveness of using carbon prices to generate revenue or channel financial resources towards projects which reduce or capture carbon. Regarding carbon taxes, it should be noted that their implementation seeks to destroy the basis for their purpose (reduction of emissions). Therefore, it should be borne in mind that the resources they provide will tend towards zero as the economy moves towards carbon neutrality.

Box 3. *The Case of Colombia. A Carbon Tax for the Environment, with Potential to Generate Revenue and Finance Climate Action*

Since its implementation in 2017, Colombia has had one of the region's most developed carbon pricing mechanisms. It seeks to address national commitments to reduce greenhouse gas emissions (Ministry of Environment and Sustainable Development, 2022). To this end, Colombia taxes emissions through a specific tax applied to the use and consumption of fuels. Specifically, the tax is levied on the first activity in the supply chain for the sale, import, or self-supply of gasoline, kerosene, jet fuel, diesel fuel, and fuel oil. In other words, it is levied either when the fuel is sold domestically; when the fuel producer withdraws it for their own consumption; or when it is imported (Aguilera et al., 2023).

As of January 2023, the price of the tax was $23,394 Colombian pesos per ton of CO_2 equivalent, the equivalent of US$5 (DIAN, 2023a). For its collection, each type of fuel has a tax conversion to a typically traded volume unit. Thus the carbon tax translates into a charge on regular gasoline equivalent to COL$169 pesos (US$0.40) per gallon (approximately 3.8 liters), $230.52 for a gallon of jet fuel (US$0.55) or $224.82 for a gallon of kerosene (US$0.55). From 2025, coal will also gradually begin to be taxed, with a starting point at 25 percent of the total tax.

The carbon tax also takes into account certain exemptions. In the case of liquefied and natural gas, this only applies to sales to industrial users in the first case, and to the petrochemical and refining industry in the second. Exemptions also include fuel alcohol (ethanol), biodiesel produced from vegetable products, fuels sold in the departments of Guainía, Vaupés and Amazonas; and the sale of marine diesel and refueling for international shipments (Aguilera et al., 2023).

To date, there are few studies on the taxes' direct impact on incentivizing emissions reductions. However, the tax has the potential to generate and channel resources for climate action, thanks to there being a specific destination for revenue collected and due also to the non-taxation mechanism, an emissions compensation system that enables resources to be channeled towards projects for mitigation.

On one hand, the non-taxation mechanism allows those companies subject to the tax to offset their emissions and certify their carbon neutrality. Specifically, the non-assessment mechanism recognizes greenhouse gas emission reductions and removal initiatives. Under an established certification process, companies subject to the carbon tax can purchase emission reductions credits instead of paying the tax, for up to 50 percent of the carbon tax payment. This mechanism has fostered a national credit market with numerous mitigation initiatives, mainly in the forestry sector.

On the other hand, in 2022 the carbon tax collected $423,904 million pesos (approximately US$101 million), reaching a total of $2,275,096 million (DIAN, 2023b). This revenue has generated resources for the environmental sector that exceed even the Ministry of Environment's previous budgets. Though different allocation schemes have been established for these resources, from 2023 onwards 80 percent of the carbon tax revenue will be allocated to the Sustainability and Climate Resilience Fund (FONSUREC) and 20 percent to the Colombia in Peace Fund. In the case of the Colombia in Peace Fund, the resources will be allocated to the Comprehensive National Program for the Substitution of Illicitly Used Crops (PNIS). In the case of the FONSUREC, the resources are to support climate action in line with the nationally determined contributions, and to support the reduction and the monitoring of deforestation; the conservation of water sources; and the protection, preservation, restoration, and sustainable use of strategic areas and ecosystems (Article 49 of Law 2277 of 2022).

3.6 Credit Markets and Compensation Mechanisms

Instruments of carbon credit markets and offset systems are the most frequently mentioned by ministries interviewed, and also present numerous challenges. The institutional capacity to adequately design, administer, and oversee carbon pricing is a determining factor for their meeting the intended objectives (Russell and Powell, 1996). In particular, creating and regulating carbon credit markets requires an institutional framework that, among other actions, defines and applies standardized methodologies, validates and registers credit-emitting projects, and monitors the status of sinks (OICU-IOSCO, 2022). The literature has highlighted the complexity of developing this type of market, where many of the reduction projects that are financed, overestimate their effects (West et al., 2020) or do not end up as emission reductions as a result of the voluntary market (Cullenward and Victor, 2020; Calel et al., 2021; Greenfield, 2023). Therefore, having the capacity to control and monitor is particularly important where the activities in question are required to operate with permanent additionality and avoid leakage of harmful activities to other jurisdictions (Haya, et al. 2020; Songwe, Stern and Bhattacharya, 2022).

In addition, Ministries of Finance will also need to consider that the cooperation mechanisms of Article 6 require corresponding adjustments between the transferring and receiving parties. Therefore, to avoid double counting, transferring countries must deduct those emission reductions from their NDCs, that is, from their emission reduction/carbon neutrality commitments. In this sense, a carbon tax that contributes to reducing emissions can have its effect in contributing to meeting the domestic emission reduction commitments neutralized if its payment is offset by carbon credits sold to non-domestic entities under Article 6.

In their current state, and taking into consideration the costs of implementation, carbon credit markets may prove insufficient for financing projects to reduce or capture carbon. For example, in 2021, voluntary markets generated almost US$2 billion globally (Songwe, Stern and Bhattacharya, 2022), because the average prices per ton of emissions are low; less than US$5 in recent years. However, for LAC alone, it is estimated that, in order to achieve a climate-resilient and zero-emission economy, it is necessary to redirect between 7% and 19% of the region's gross domestic product (GDP), which amounts to around US$1.3 trillion annually (Galindo Hoffmann, and Vogt-Schilb, 2022).

3.7 Relevance of Subsidy Management and Exemptions

It is also important to consider phasing out fossil fuel subsidies and tax exemptions for specific polluting activities. In particular, subsidies play an inverse role in carbon pricing policies and overshadow the impacts of carbon pricing, both from the incentive, and the tax revenue points of view. "Indirect prices" account for around 85 percent of the total carbon price (Agnolucci et al., 2023). Taking into account all taxes, exemptions, and energy subsidies, the indirect price reaches a value of US$18/$tCO_2$ for LAC, (although with important differences between countries), which is much lower than the OECD average of approximately US$43/$tCO_2$ (Ahumada et al., 2023). The low share of direct carbon prices in the total price, and the presence of exemptions and subsidies to fossil fuels, weakens the impact of these instruments. A recent study analyzing the "indirect" carbon price for 142 countries between 1991 and 2021, finds that the overall rate has remained relatively constant since 1994, with minor increases (Agnolucci et al., 2023).

One study estimates that explicit fossil fuel subsidies totaling US$1,278 billion were granted globally in 2021 (Black et al., 2023), a figure much higher than the record US$95 billion in global carbon price revenues generated the same year (World Bank, 2023a). In 2020, LAC countries granted fossil fuel subsidies equivalent to 1.3 percent of their gross domestic product, equivalent to US$60 billion (Parry, Black, and Vernon, 2021). Reforming such subsidies is important for aligning public spending with climate action and discouraging the use of polluting technologies. However, such policies can be strongly opposed by the public, as can setting carbon prices (Funke and Merrill, 2019; Green, 2021a).

Mexico presents an excellent case of overcoming barriers and eliminating fossil fuel subsidies. Subsidy schemes were designed by fixing pricing for fuels through the state-owned companies, PEMEX. By way of a series of reforms, subsidies were gradually eliminated in 2012, which led to the vertical and horizontal disintegration of PEMEX and the liberalization of the market. Implementing this reform has made it possible to achieve positive net tax burdens on fuels since 2015. In turn, in 2016, the government established a price band of +/- 3 percent on gasoline and diesel to control the impact of market liberalization and during 2017 allowed a 20 percent increase in gasoline prices (OECD, 2017). The success of this reform is consistent with the literature review that shows there is less opposition to carbon pricing mechanisms if they are implemented gradually (Carattini, Carvalho, and Fankhauser, 2018).

3.8 Differences in Effectiveness between Carbon Pricing Instruments

Types of carbon pricing instruments differ in design and have advantages and disadvantages in implementation and impact. In general, evidence shows that carbon taxes have generated greater reductions than emissions trading systems. For example, Green (2021b) notes that the European Union's tradable emissions trading system (EU-ETS) has generated reductions in the range of 0 to 1.5 percent per year, which is lower than the aggregate effectiveness result of carbon pricing instruments of 0 to 2 percent per year.

Both emissions trading systems and taxes seek to establish a carbon price; however, their design differences mean they behave differently. Setting a carbon tax exogenously fixes the price and leaves the amount reduced/emitted to adjust. On the other hand, tradable emissions systems set an emissions quota, giving certainty in the quantity to be reduced, but generate uncertainty regarding the price, which occurs through market equilibrium. Both mechanisms have advantages and disadvantages, among which are the following (Goulder and Shein, 2013):

Unlike carbon taxes, **tradable emissions systems** must be constantly updated as new emission-reducing technologies emerge, or reduction targets become more stringent.

Emissions trading systems minimize the distributional impacts of carbon pricing through the ability to allocate emission permits to the most adversely affected sectors.

An **emissions trading system** applied to emission sources (downstream) reduces the need to use the border adjustments that jeopardize the competitiveness of local fossil fuel production in the short term.

Unlike emissions trading systems, **carbon taxes** do not generate carbon price volatility, thereby removing this risk for sectors vulnerable to carbon.

Carbon taxes are best complemented by other policies which promote emissions reductions. Under an emissions trading system, the volume of reduction is determined by the number of permits. Implementing policies in parallel causes the price of permits to fall.

4

FINDINGS AND RECOMMENDATIONS

4. Findings and Recommendations

4.1 The Need for Structural Transformations and the Role of Economy and Finance Ministries

Achieving carbon neutrality by 2050 requires treating climate change mitigation as a problem of the re-structuring of society and not just as a market failure (Green, 2021a). Effective environmental policy will require implementation of multiple instruments to remove the barriers that prevent public and private sectors from investing in net-zero emissions solutions (see Section 3.2). These include actions to build the necessary infrastructure, reform regulations, provide targeted subsidies, build capacity, provide information, and offset distributional impacts (Fazekas, Bataille, and Vogt-Schilb, 2022).

The role of economy and finance ministries is fundamental for enabling the necessary transformations to achieve carbon neutrality. Fazekas, Bataille, and Vogt-Schilb (2022) show that government interventions are mainly sectoral. However, sectors will require the support of economy and finance ministries to achieve their climate objectives, both in their budgetary role, and through the fiscal, financial, and tax incentives they can implement. For example, to overcome barriers to the implementation of renewable energies, accelerated investment depreciation schemes can be designed and the issuance of sustainable bonds or state guarantees can be promoted, thus improving the financial position of these projects and their access to financing (Krogstrup and Oman, 2019). The fiscal, financial, and financing enabling role of economy and finance ministries in securing emission neutrality should be based on support for overcoming barriers and on achieving the necessary sectoral transformations.

One of the interventions that finance ministries could make to contribute to this transformation is alignment of economic strategy and vision, for example, developing tools or models for prioritizing public investment projects, based on their contribution to decarbonization and resilience, or applying cost-benefit evaluation methodologies for projects based on criteria aligned with decarbonization goals. Fiscal policy is also vital, and includes setting carbon prices and reviewing fossil fuel subsidies. Other types of fiscal policies can also be considered, including loan and guarantee programs, credit deductions, traditional taxes, technology-specific subsidies, and direct cash transfers. However, it is important to note that many fiscal policies represent an additional cost, while carbon pricing generates revenue. Finally, finance ministries can consider financial sector regulation and budget management, including identifying and assessing the positive and negative climate effects generated by public spending (Coalition of Finance Ministers for Climate Action, 2023; Delgado et al., 2023).

4.2 Well-Designed Carbon Pricing: One of Many Instruments

Carbon pricing is not necessary for achieving emissions neutrality, but it can play a role as one of several instruments. Implementing carbon pricing should be subject to narrow objectives, based on a long-term vision in alignment with the transformations necessary for achieving emissions neutrality. When properly designed, carbon prices are instruments that can incentivize emissions reductions in a flexible way. However, it is important to bear in mind the magnitude of the reductions that can be achieved; these take time to materialize and the instrument itself also takes time to be implemented. Two recommendations to improve their effectiveness emerge from the literature review (see Section 3.3):

Inclusion of carbon pricing within a policy package: Carbon pricing is most effective within a package of public policies, both fiscal and non-fiscal. Ultimately, changing the relative price of polluting activities will be more effective in incentivizing the abandonment of polluting activities, if the barriers that prevent this are removed through other policies in the first place. In turn, implementing carbon pricing helps other types of policy instruments be more effective in promoting decarbonization.

Consider sector-specific carbon pricing: Carbon pricing may be a more effective policy from a sectoral perspective, adjusting to the needs and barriers of each sector, or focusing on those sectors where it can be most effective.

Carbon pricing can be a source of financing to support environmental policy, but good fiscal practices must be followed through in managing it (see Section 3.5). Revenues from carbon prices can be allocated to funds that usually finance more temporary expenditures, as shown in the case of Colombia's carbon tax (see Box 2). Similarly, a carbon offset system would allow for the generation of private financing for environmental or climate initiatives.

To implement carbon pricing, its distributional impact must be mitigated and its acceptability improved. As highlighted in Section 3.4, and in the case of Mexico discussed in Section 3.7, a carbon pricing instrument (or subsidy reform) can gradually improve its acceptability to the public (Carattini, Carvalho, and Fankhauser, 2018). Another alternative to enhance the acceptability of implementing carbon pricing instruments is to compensate those most adversely affected (see Numeral 3.4). However, existing transfer and compensation mechanisms may be imperfect, potentially leaving many of those most affected by carbon pricing without access to these compensatory benefits. Governments seeking to compensate households can expand the coverage of existing cash transfer programs or consider complementary instruments such as in-kind transfers or the elimination of existing distortionary taxes (Missbach, Steckel, and Vogt-Schibs 2023). Additionally, policies within a broader framework for a just transition must be considered, including sectoral, labor, social, and industrial policies (Alfonso et al., 2023).

The benefits and impacts of implementing carbon pricing instruments should be evaluated. An important point to highlight is that there are already multiple experiences with carbon taxes and emission credit markets in Latin America, several of which have been implemented for some years. However, there are no evaluations as to their effectiveness in incentivizing emissions reductions. If carbon pricing instruments are available, conducting periodic ex-post evaluations of their effectiveness is important. On the other hand, the benefits of implementing a carbon pricing instrument –both in terms of emission reductions and monetary benefits- should also be evaluated "ex-ante", contrasting it with the costs of implementation, instructional infrastructure, and additional bureaucracy for those affected.

4.3 Creating and Strengthening the Institutional Framework

Implementing effective revenue policies and fiscal incentives requires creating and strengthening the institutional framework in economy and finance ministries and sectoral ministries in the following ways: First, it is important to know how to design revenue instruments and fiscal incentives which accommodate national realities and realistic national climate action objectives. Economy and finance ministries must also be able to evaluate carbon pricing policies or other economic instruments in terms of their impact on emissions reductions and revenue-raising capacity. To effectively enforce restrictions on emissions (whether a direct restriction or the payment of taxes), and for the proper functioning of an offset market, there must be the capacity to implement monitoring, reporting, and verification (MRV) systems.

4.4 Subsidies and Tax Exemptions

A prior step to implementing carbon pricing is to consider the gradual elimination of fossil fuel subsidies and tax exemptions for specific polluting activities. As shown in Section 3.7, these can represent up to 85 percent of the total carbon price, which is a preponderant element for Latin America and the Caribbean.

5

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6

ANNEX: SUMMARY OF RESULTS OF SEMI-STRUCTURED INTERVIEWS BY TYPE OF INSTRUMENT.

Box A1. *Carbon Taxes*

Instrument	No. of countries	Aspects of the instruments	No. of countries	Expectation and objectives	No. of countries	Barriers	No. of countries
Carbon tax	**7**	**Fixed sources**	1	**Support:** Support environmental policy through fiscal policy.	4	**Low Prices:** Current (or potential) prices are too low to be an effective incentive.	1
		Mobile sources	6	**Incentive:** Corrective incentive, elimination of externalities and dissuasive purpose.	5	**High Prices:** Difficult to implement high prices given economic/political/social contingency/fair transition. Leakage is included where high prices may displace activities to lower tax areas.	3
		Tax revenue neutral: The establishment of the tax does not represent an additional tax burden for taxpayers.	2	**Revenue:** Raise revenue to finance environmental policy or economic policy that supports the environment.	4	**Adding new taxes:** No desire to add more taxes/difficulty to implement new taxes.	3
		Income associated to expense: Income cannot be directly associated to a specific expense.	4	**Fiscal origin:** Generally, taxes on fuels not defined in carbon emissions have a fiscal revenue origin.	3	**Lack of technical knowledge and information**	**4**
		Taxes on fuels or emissions not defined in terms of CO2 are highlighted.	5			**Other barriers:** e.g., lack of public transportation, political difficulties to implement carbon pricing.	2

Note: The "N°" columns indicate the number of countries associated with the one specified in the column to the immediate left. Countries may appear in more than one response, thus, columns do not add up to total number of countries. The aspects column identifies countries that already have a carbon pricing mechanism or those interested in implementing one.

Box A2. Credit Markets and Tradable Emissions Systems

Instrument	No. of countries	Aspects of the instruments	No. of countries	Expectation and objectives	No. of countries	Barriers	No. of countries
Credit Markets and Tradable Emissions Systems	**8**	**Carbon credit markets for carbon tax offset mechanisms.**	3	Support: Support environmental policy through economic policy, including meeting international commitments (NDC, ESG, etc.).	5	Low Prices: The prices of the associated carbon tax are low. There are few projects in the credit markets that are convenient to buying the credits in lieu of paying the tax.	1
		Emissions trading system (Cap and Trade or similar).	**4**	Mobilize resources: Promote investment in green sectors and projects that absorb/reduce emissions.	4	Financial Additionality: financing from carbon credit markets should be directed to projects where financial resources provide financial viability.	2
		Develop credit markets associated with Article 6	**3**	Revenues: Raise to finance environmental policy or economic policy that supports the environment (subsidies)/cover fiscal deficit for environmental policy	2	**Land tenure: Lack of legal land tenure makes it difficult to use land for carbon credit market projects.**	**2**
				Incentive: Corrective incentive, elimination of externalities and dissuasive purpose of the emissions trading system.	2	MRV: Institutional capacity to monitor and	1
						Information and/or knowledge: Lack of information to develop markets in key sectors.	2
						Illegal activities: Illegal deforestation hinders the effectiveness of this type of instrument.	1

Note: The "N°" columns indicate the number of countries associated with the one specified in the column to the immediate left. Countries may appear in more than one response, thus columns do not add up to total number of countries. The characteristics column identifies countries that already have a carbon pricing mechanism or those that are interested in implementing one.

Box A3. The Instrument Is Not Specified

Instrument	No. of countries	Aspects of the instruments	No. of countries	Expectation and objectives	No. of countries	Barriers	No. of countries
They express interest but have not yet defined the instrument(s).	2	No instruments have been defined	2	Support: Support environmental policy through economic policy.	2	Defining the price the mechanism should have	1
				Comply with international commitments (NDC, ESG, etc.) or national legal commitments.	2	Technical knowledge	1
				Corrective incentives: Correcting	1	High levels of informality hinder credit markets.	1
				Revenues: Raising funds to finance policy without specifying its objective	1	Social and political difficulty of imposing new taxes.	1

Note: The "N°" columns indicate number of countries associated with the one specified in the column to the immediate left. Countries may appear in more than one response thus columns do not add up to total number of countries. The characteristics column identifies countries that already have a carbon pricing mechanism or those that are interested in implementing one.

Box A4. Consolidated All Instrument

Instrument	No. of countries	Aspects of the instruments	No. of countries	Expectation and objectives	No. of countries	Barriers	No. of countries
Carbon Tax.	7	Tax revenue neutral: Establishment of the tax does not represent an additional tax burden for taxpayers.	1	Support: Support environmental policy through fiscal policy.	8	High/Low Prices: Difficult to implement high prices given the economic/political/social contingency/fair transition. Conversely, current (or possible) prices are identified as very low.	3
Carbon Credit Markets.	6	Non-affectation: The income cannot be directly associated to a specific expense.	4	Incentive: Corrective incentive, elimination of externalities and dissuasive purpose.	7	Adding new taxes: Do not want to add more taxes or identify difficulty in implementing new taxes.	4
Transmittable Emission Systems.	4	Instrumentos similares: Se destacan instrumentos similares.	5	Revenue: Raise revenue to finance environmental policy or economic policy that supports the environment.	5	Lack of technical knowledge, information or skills.	6
No definition has been made.	2	Carbon credit markets for a system of carbon tax offsets.	3	Mobilize resources: Promote investment in green sectors and projects that absorb/reduce emissions.	4	Financial Additionality: financing from carbon credit markets should be directed at projects where financial resources provide financial viability.	2
		The markets for carbon credits associated with Article 6	3			Land tenure: Lack of legal land tenure makes it difficult to use land for carbon credit market projects.	2

Note: The "N°" columns indicate the number of countries associated with the one specified in the column to the immediate left. Countries may appear in more than one response, thus, columns do not add up to total number of countries. The characteristics column identifies countries that already have a carbon pricing mechanism or those that are interested in implementing one.


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