Economic policy and climate change

Carbon pricing in Latin America and the Caribbean

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Abstract

The latest reports of the Intergovernmental Panel on Climate Change (IPCC) point to the need for countries to step up their climate action initiatives and make more ambitious commitments concerning the reduction of greenhouse gas (GHG) emissions if the objectives of the Paris Agreement are to be achieved. Viewed from an economic standpoint, GHG emissions are a negative externality. One way of trying to correct that market failure is to internalize the social costs of emissions in the production costs of the sources of emissions and/or in the consumption decisions of the agents who generate them. This is the reason for putting a price on carbon. This study provides an overview of the economic policies being used in the region to address climate change and then focuses on the use of the various carbon pricing tools available in the Latin American and Caribbean countries. It also underscores the importance of the role to be played by finance ministries and draws attention to the limited extent to which use is being made of carbon taxes in the region. In fact, such taxes are in place only in Argentina, Chile, Colombia, Mexico and Uruguay and, even in those countries, are levied on only a relatively small proportion of GHG emissions, while Mexico is the only country in the region that is implementing an emissions trading system. Another form of carbon pricing is the use of shadow prices (the social price of carbon) in investment project evaluation procedures in order to shift the profitability ratios of investments towards low-carbon ventures. In addition to discussing the concerns surrounding the use of fossil fuel subsidies in the region, the study looks at the situation with regard to climate finance and notes that, for every dollar invested in climate action in Latin America and the Caribbean between 2013 and 2022, US$ 9.8 was spent on fossil fuel subsidies. The results of different scenarios for the reform of fossil fuel subsidies in terms of the impact on income, GHG emissions and welfare are also presented.

Introduction

The Intergovernmental Panel on Climate Change (IPCC) has produced evidence of the anthropogenic origin of climate change, with the main factors being emissions from the burning of fossil fuels and changes in land use. It has consequently warned that, in order to limit global warming to 1.5°C, emissions of greenhouse gases (GHG) will need to be reduced by 43% from their 2019 levels by 2030. From an economic standpoint, the GHG emissions that are fuelling climate change are viewed as a negative externality, which justifies the setting of carbon prices at a level that will internalize their associated costs. There are various ways of doing this. These prices can be set explicitly by introducing a carbon tax or an emissions trading system (ETS), or shadow carbon prices can be incorporated into financial instruments and investment evaluation procedures in order to shift the investment profitability ratios towards low-carbon projects. Meanwhile, fossil fuel subsidies act as *negative* carbon prices. And, in fact, an analysis of the data on climate finance and on fossil fuel subsidies indicates that the Latin American and Caribbean region devotes a much greater amount of budgetary resources to the subsidization of fossil fuels than it does to climate action.

Although decision makers are well aware of these policy instruments, their use in dealing with climate change is still quite limited in Latin America and the Caribbean. This study will provide an overview of carbon pricing in the region, with an emphasis on the use of the associated economic policy tools and the role of finance ministries in carbon pricing and in the use of fiscal policies having an environmental component. It offers a wide range of analyses and statistical and other data from a variety of international sources and from studies conducted by the Economic Commission for Latin America and the Caribbean (ECLAC) that can serve as useful inputs for technical discussions and decision-making by finance, economic, energy, planning and environmental ministries.

The study is divided into three sections. The first presents a brief analysis of the global objectives of decarbonization under the Paris Agreement and the challenges facing the Latin America and Caribbean region as it strives to fulfil its emissions reduction commitments. The second deals with climate action as it relates to economic policy. It delves into the use of economic policy tools for this purpose, the importance of green fiscal policy, the use of environmentally targeted taxes, fossil fuel subsidies and the adjustments that need to be made in fossil fuel prices in order to internalize the social costs of the use of such fuels. This section also explores the status of climate finance in the region and the use of climate finance tools such as green bonds. The third section looks at carbon pricing arrangements in the countries of the region, including both carbon taxes and tradable emissions permit systems, along with the use of the social price of carbon in the context of investment evaluation processes. It then goes on to take a critical look at the effectiveness of carbon pricing and the economic and environmental impacts that a reform of fossil fuel subsidies would have. The study closes with conclusions and key messages.

I. The Paris Agreement, decarbonization and challenges for Latin America and the Caribbean

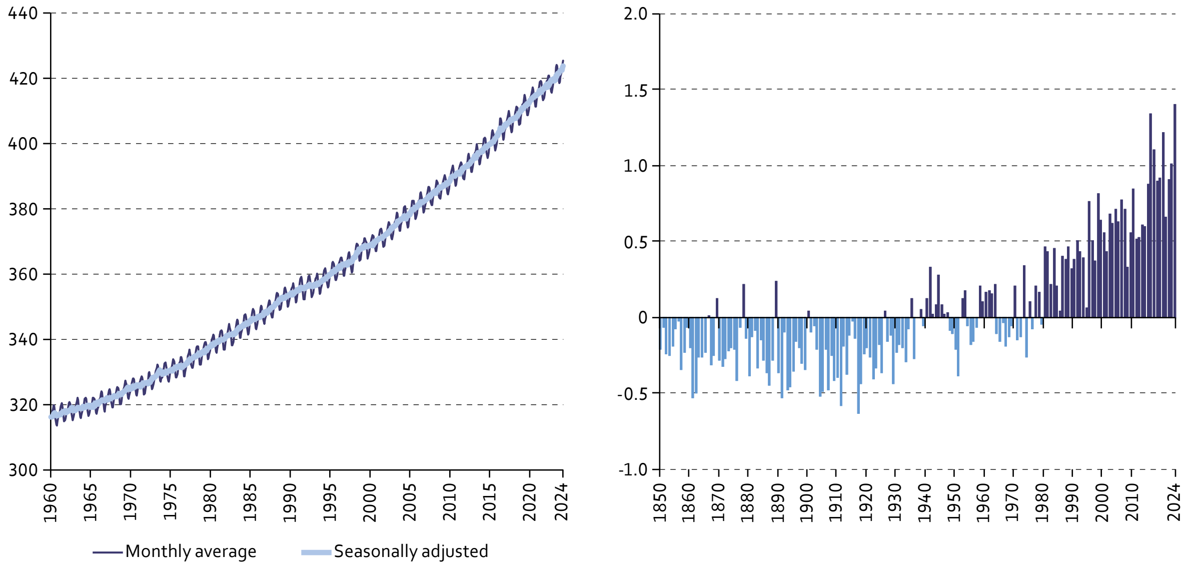
In its latest reports, the Intergovernmental Panel on Climate Change (IPCC) has underscored the need for countries to step up their climate action initiatives and set more ambitious emissions reduction goals if the Paris Agreement objective of holding the increase in global temperatures to 1.5°C is to be achieved. Yet the world has not managed to turn around the existing trends in the variables associated with anthropogenic climate change. Rising emissions have been one of the factors driving increasing concentrations of carbon dioxide (CO_2) in the atmosphere. The most recent measurements indicate that CO_2 concentrations as of March 2024 were 425 ppm (see figure 1). The warming of the oceans and the rapid melting of snow cover helped to raise worldwide sea levels by an average of 4.77 mm per year starting in 2014 to a new record high in 2023 (WMO, 2024). The last decade has been the warmest ever recorded, and the last four decades have been hotter than any other decades since 1850. In 2023, the global annual mean temperature near the planet's surface was 1.45, ± 0.12°C, above the preindustrial mean for 1850–1900. Land and oceanic temperature anomalies are depicted in figure 1.

Given countries' emissions reduction commitments as set out in their updated nationally determined contributions, it is estimated that the emissions gap that needs to be bridged in order to limit global warming to 1.5°C in 2030 is between 20 and 24 gigatons of CO_2 equivalent and that to remain on the path to 1.5°C, world GHG emissions will need to be reduced by 43% by 2030 and by 60% by 2035 relative to their 2019 levels and that net zero CO_2 emissions will need to be attained by 2050 worldwide (UNFCCC, 2023).

Figure 1
CO_2 concentrations and average land and ocean temperature anomalies

A. Atmospheric concentrations of CO_2, 1960–2024 (I)
(Parts per million)

B. Global average land and ocean temperature anomalies in 1850–2024 relative to 1901–2000
(Degrees Celsius)



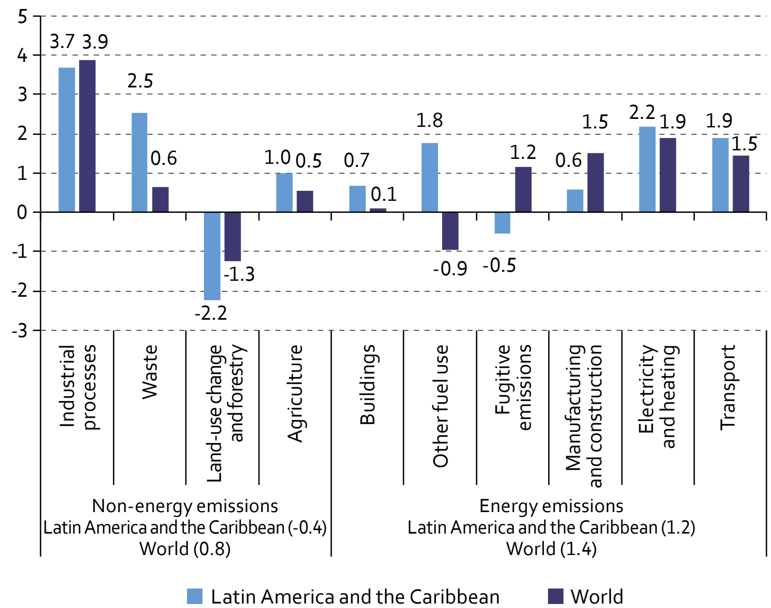
Source: Prepared by the authors, on the basis of National Oceanic and Atmospheric Administration (NOAA), Global Monitoring Laboratory [online] https://gml.noaa.gov/; Earth System Research Laboratories [online] https://www.esrl.noaa.gov/; National Centers for Environmental information (NCEI), "Climate at a Glance: Global Time Series" [online database] https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/global/time-series.

The average temperature in Latin America and the Caribbean in 2023 was the highest ever recorded. It was 0.82°C higher than the average for 1991-2020 and 1.39°C higher than the average for 1961-1990. The temperature increase in the region in 2023 was greater than in 2022 owing to the presence of El Niño. The upward trend in 1991-2023 was the steepest (approximately 0.2°C per decade or more) since 1900.

The region accounts for 10% of global emissions, but the composition of its emissions differs from the global average. In the region's case, the largest share of emissions is attributable to changes in land use (38%), followed by emissions from the energy sector (24%) and agriculture and forestry (20%). Over the last three decades (1990-2020), the region's GHG emissions from energy use climbed at an average annual rate of 1.2%, while non-energy emissions declined by an average of 0.4% per year (see figure 2). An analysis of the distribution and trends of the region's emissions makes it possible to identify different options and priorities for the design of public policies that will help the region to fulfil its emissions reduction commitments and to build its resilience.

Even though the region accounts for a relatively small percentage of global GHG emissions, its geographic position and socioeconomic situation make it extremely vulnerable to the effects of climate change and especially to extreme events. The number of disasters related to climate change is on the rise, as is the number of persons affected by those events. Droughts are the climate-related phenomenon impacting the largest share of such persons (46%) in the region.

Figure 2
Latin American and Caribbean region and the world: average annual increase in GHG emissions, 1990–2020
(Percentages)

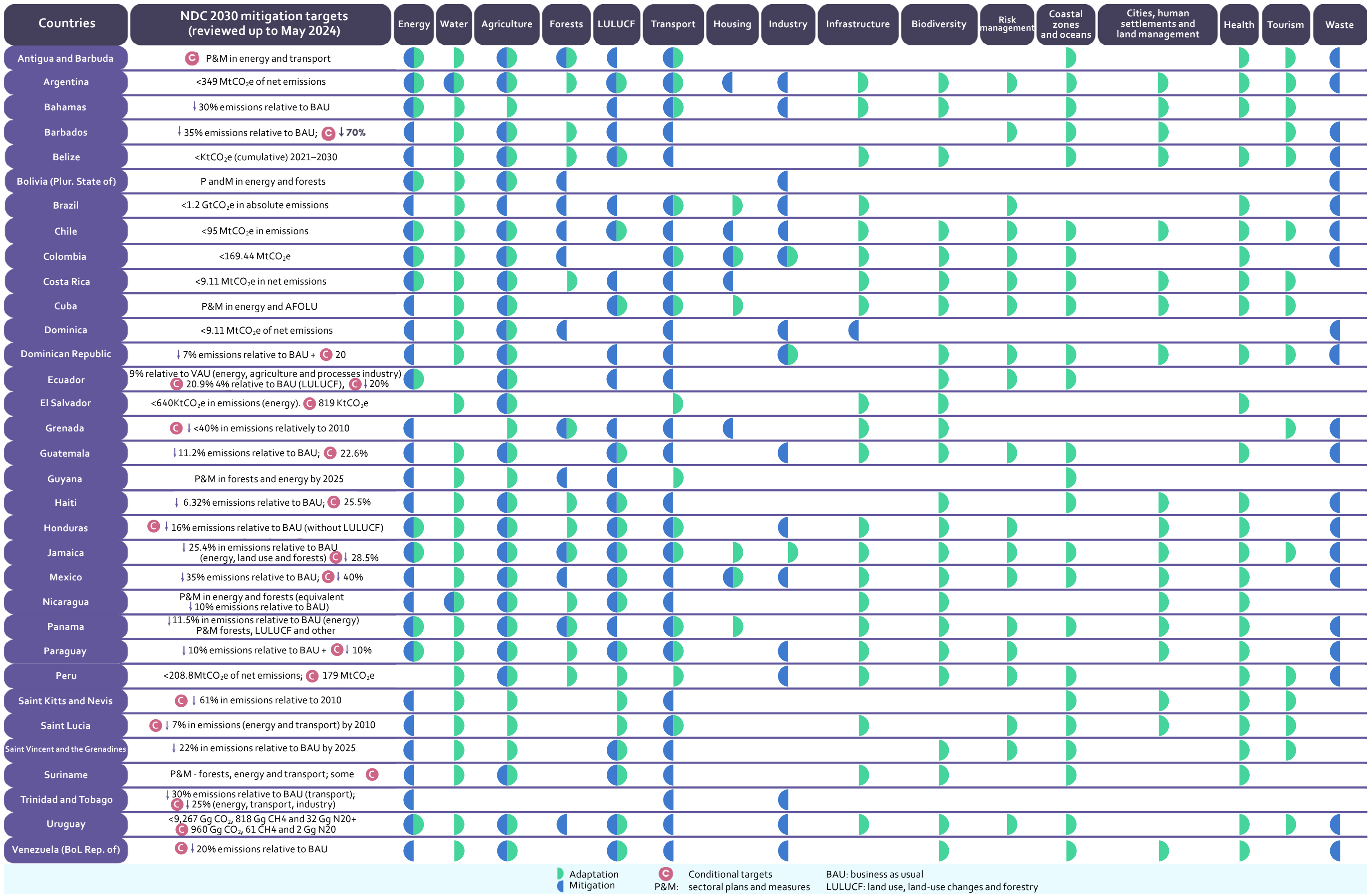


Source: Prepared by the authors, on the basis of Climate Watch, "Global Historical Emissions", Washington, D.C., 2023 [online] https://www.climatewatchdata.org/ghg-emissions.

A. Nationally determined contributions and long-term strategies

Latin America and the Caribbean have committed to the Paris Agreement. Of the region's 33 countries, 25 have updated their first nationally determined contribution (NDC), 4 have submitted a second NDC and 4 others have submitted only their first NDC to the United Nations Framework Convention on Climate Change (UNFCCC). While the situation of the countries of the region corresponds to the principle of "common but differentiated responsibilities", they have understood that mitigation is the best adaptation strategy, that improving air quality in their cities will have a positive impact on productivity and that the decarbonization of the economy will enable them to position themselves more advantageously in the world markets of the future. Accordingly, their new emissions reduction targets for 2030 are more ambitious, ranging from 24% for unconditional commitments to 29% for ones that are conditioned on the reception of international support (ECLAC, 2024). Energy; agriculture, forestry and other land uses (AFOLU); and transport are the sectors that the countries of the region have prioritized for climate action aimed at achieving emissions reduction goals (see figure 3). Adaptation also figures more prominently than it did in the first NDCs. Water, agriculture, health and biodiversity are among the sectors that more countries have prioritized for adaptation to changing climate conditions (see figure 3). As of the time of writing, 15 countries of the region had submitted their national adaptation plans to UNFCCC, and some countries have even broken those plans down by sector. Another Paris Agreement commitment assumed by the countries is the presentation to UNFCCC of their long-term strategies, with objectives defined for 2050; to date, eight countries of the region (Argentina, Belize, Chile, Costa Rica, Colombia, Guatemala, Mexico and Uruguay) have done so.

Figure 3
Priority sectors for adaptation and mitigation identified in the NDCs of Latin American and Caribbean countries



Source: Economic Commission for Latin America and the Caribbean (ECLAC), *La economía del cambio climático en América Latina y el Caribe, 2023: necesidades de financiamiento y herramientas de política para la transición hacia economías con bajas emisiones de carbono y resilientes al cambio climático* (LC/TS.2023/154), Santiago, 2024; and nationally determined contributions of Latin America and the Caribbean countries.

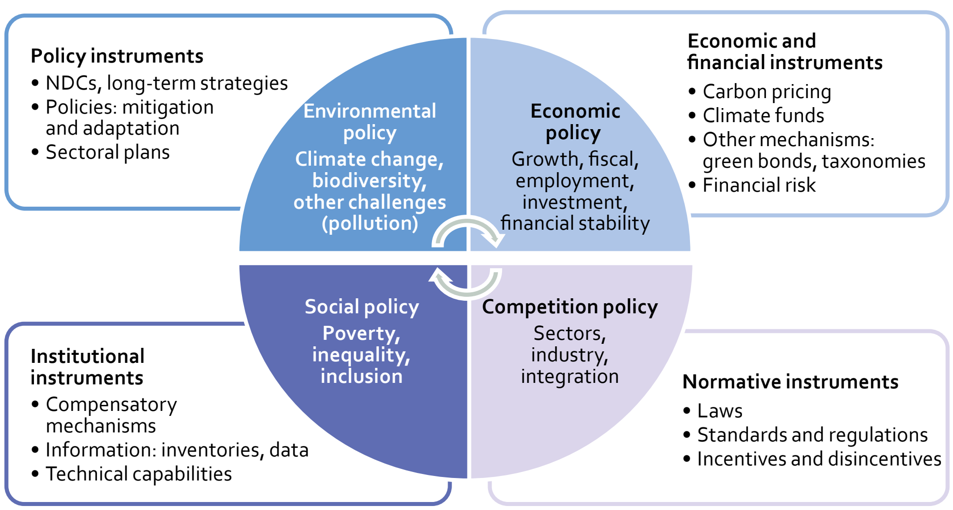
B. Decarbonization challenges

To fulfil the Latin American and Caribbean countries' unconditional and conditional emissions reduction commitments as defined in their NDCs, by 2030 the region will have to have cut its emissions by 24% and 29%, respectively, relative to what its level of emissions would be in the absence of any policy changes (business as usual). In terms of another point of comparison, the challenge also involves speeding up the pace of the decarbonization of the region's economy (decoupling GDP growth from GHG emissions) by a factor of between six and eight in order to meet the Paris Agreement goal of limiting global warming to below 2°C and, if possible, 1.5°C (ECLAC, 2024). The challenge of meeting the goal of attaining carbon neutrality by 2050 is even greater.

Achieving these objectives will require thorough-going changes in the region's economy, along with efforts to increase financing flows and align public and private investment with sectors and activities that contribute to economic growth, productivity gains and job creation while at the same time helping it to reach its climate action goals. This will also require changing standards and incentives in ways that will alter the profitability of investments so that the profitability assessment itself will prioritize low-carbon options.

Using tools such as the NDCs and long-term strategies, the countries are mainstreaming climate change decisions involving their finance, economic affairs, energy and planning ministries, but a stronger link needs to be forged between those decisions and their investment plans and budgets. The region's climate change management challenge, in this respect, is how to link up the available instruments and coordinate them with other areas of policy (see diagram 1).

Diagram 1
Climate change management and sectoral policy tools



Source: Prepared by the authors.

II. Economic policy and climate action

The climate crisis has been a focus of attention for decision makers at the highest level in recent years because of its economic, social and ecological implications. One indication of this is the increased involvement of finance, economic affairs, energy, agriculture and planning ministries, financial authorities, and central banks in the formulation of national climate action commitments such as those made in countries' NDCs and long-term strategies and in the design of public policies dealing with climate change. Consequently, economic and fiscal policy are playing a more important role in the design of policies and plans aimed at cutting GHG emissions, increasing countries' resilience to climate change, promoting investment in low-carbon sectors and securing financing for the transition towards decarbonized economies.

Economic and non-market-based normative and regulatory tools are some of the various types of instruments that are being used for those purposes. Some of the best-known normative tools are standards, laws and bans, support for green-technology research and development, the removal of barriers and the generation of information (Sterner and Coria, 2012). In drawing up regulations concerning the analysis of financial risks stemming from climate change, regulatory authorities should work with the relevant financial institutions to design and make public the corresponding implementation and related information disclosure standards. Regulation in this area can only be carried out successfully if use is made of the new types of tools that are now being developed. Navigating the learning curve together, as a joint venture, is a more constructive approach to take.

Economic and fiscal policymakers have been focusing more on using economic policies as climate change management tools. These tools include carbon taxes, emissions trading systems (ETSs), emission reduction purchase agreements (ERPAs), public procurement policies, subsidies for energy efficiency, renewable energy sources, research and development, and the elimination of fossil fuel subsidies. All of these devices are means of providing economic incentives for reducing emissions. Carbon taxes and ETSs are the most cross-cutting tools and are therefore the most widely used ones. They have also proven to be the most effective low-cost means of promoting reductions in emissions (IPCC, 2022).

In order to further their sustainable development, the countries will need to improve the integration of economic policies for spurring economic growth and development with climate and environmental policies aimed at putting a stop to the environmental degradation caused by existing production and consumption patterns. One of the ways of doing this is through the use of fiscal policies that incorporate environmental content, more commonly known as "green fiscal policies". Advanced countries started to do this in the 1990s by embedding economic instruments (mainly in the form of taxes) in fiscal reform measures that have positive environmental effects.

These environmental fiscal measures have made changes in countries' tax systems that alter conventional (labour and capital) tax loads by taxing environmentally harmful activities more heavily (Bosquet, 2000 and EEA, 2005). Thus, green tax reforms are a special type of revenue-producing economic policy instrument for curbing pollution and natural resource use (Ekins and Speck, 2011). The three main aims of these kinds of reform measures are: (i) to reduce or eliminate environmentally harmful subsidies; (ii) to restructure existing taxes in environmentally beneficial ways; and (iii) to introduce new environmental taxes (Barde, 2005).

Well-designed green tax reforms have the potential for generating a double dividend. The first objective of any green tax reform is to help to reduce emissions of pollutants having negative externalities (*the environmental dividend*). Such reforms can also, however, serve economic/fiscal purposes if the revenues that they generate are used to reduce other distortionary taxes (*the revenue recycling effect*) (Parry and others, 1999). For example, environmental tax reforms can also be used to help achieve economic and labour-related objectives if the revenues generated by such taxes are used to reduce social security taxes or payroll taxes, thereby contributing to job creation and economic buoyancy (Fanelli, 2015; Rodriguez, 2001). In any event, the double dividend hypothesis is a subject of intense academic debate. Bovenberg and de Mooij (1994) argue that, by increasing the prices of pollution-producing goods, environmental taxes implicitly reduce real wages and the labour supply, thereby introducing distortions into the labour market as a result of the *tax interaction effect*. On the other hand, Kahn and Farmer (1999) contend that, by improving the quality of the environment, environmental taxes have a direct positive impact on utility and thus increase people's welfare while also having an indirect impact in the form of gains in productivity attributable to a healthier environment. According to this line of argument, improvements in people's health will increase the labour supply and the productivity of the workforce, which will spur labour demand and economic activity in general (Rodriguez, 2001).

Environmental fiscal reforms, in this broad sense, have not been carried out in Latin America and the Caribbean, but many countries of the region are using environmentally related economic instruments (taxes, rates, etc.) in order to provide greater fiscal space and/or as part of policies designed to address climate change, improve air quality, preserve biodiversity and protect the environment. The fiscal problems generally found in the countries of Latin America and the Caribbean (disequilibria, excessive levels of indebtedness and tax evasion, among others), the level of institutional development and the need to obtain financing for social programmes are just some of the reasons why it appears that the countries of the region are not placing priority on substituting environmental taxes for conventional forms of taxation.

Fiscal policymakers in the region could give some consideration to expanding the tax base to include more goods, production processes and industries that produce GHG emissions and damage the environment; to reducing environmentally harmful subsidies as an alternative means of expanding fiscal space, freeing up funds for programmes aimed at fulfilling climate action commitments and helping to restore the environment; and sending signals that will oblige polluters to assume the social costs of the damage they cause. The message is therefore that steps need to be taken to weigh the advantages of taxing fossil fuels, carbon emissions and the purchase of motor vehicles that produce pollutants that, at the local level, harm people's health and that, at the planetary level, are contributing to global warming and of using other fiscal tools to disincentivize activities that have environmentally harmful externalities.

Efforts in these areas should be viewed as part of a broader approach than the green fiscal reforms mentioned above, however. Environmental taxes have historically accounted for no more than 4% of total tax revenues for the region (see figure 4) and, in order to bring about an environmentally desirable drop in collections (in terms of the countries' sustainable development) from high-emissions sectors, fiscal policy needs to be thought about in terms of a fiscal transition. This will entail taking a new look at how macroeconomic scenarios play out in a world subject to climate change, the consequences of the resulting structural changes and, on that basis, tax expenditure, public investment, other expenditure, the design of taxes, the determination of the public budget and the duration and scope of incentives required by the demands of the climate transition. These scenarios should incorporate the foreseeable changes in the labour market that will be driven by artificial intelligence, robotics and the digitalization of commerce.

The idea of a fiscal transition of this nature is closely linked to a consideration of the role that environmental taxes can play in changing production patterns in ways aligned with the objectives of sustainable development and the Paris Agreement at a time when disruptive technologies and geopolitical changes are swaying global markets. Carbon pricing, in any of its forms, as a tool for helping to decarbonize the economy can be more successfully designed and implemented within the conceptual framework of just such a fiscal transition.

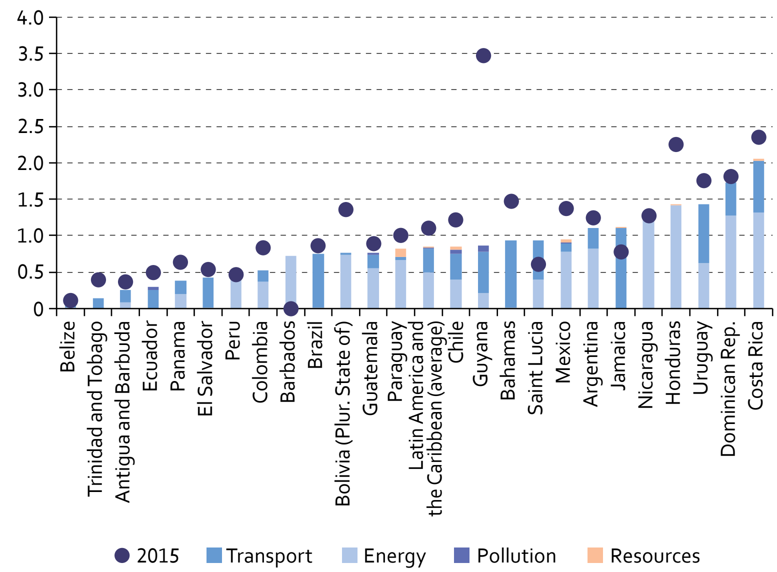
A. Green taxes

In a region so rich in natural capital as Latin America and the Caribbean, where natural resources account for such a large part of the countries' incomes, there is an ongoing conflict between the relative priorities placed on economic, social and environmental objectives. This is especially true in the presence of a development style that gives greater weight to income growth than to environmental protection. In this context, green taxes are an important component of the economic toolbox for dealing with climate change and other negative environmental externalities. Such taxes can be used in a variety of sectors or activities that can do harm to the environment, such as transport, energy consumption, waste generation, and local and global emissions of pollutants.

In Latin America and the Caribbean, the use of these policy instruments is concentrated in the energy and transport sectors, where they mainly take the form of taxes on fuels, motor vehicles and electricity use. They are just beginning to be levied —somewhat hesitantly— on carbon content. The fact that the use of green taxes has not increased a great deal in the region is reflected in the level of fiscal revenues that they generate, and the picture becomes even clearer if that level is compared with the revenues generated by green taxes in other regions of the world.

Figure 4 shows the revenues generated by environmental taxes as a percentage of GDP in the countries of Latin America and the Caribbean in 2015 and 2022. For the region as a whole, green tax revenues amounted to 0.84% of GDP in 2022, well below the corresponding figure for the countries of the Organisation for Economic Co-operation and Development (OECD) (1.92% of GDP). The largest share of fiscal revenues in the Latin American and Caribbean region has come from energy taxes, which have averaged roughly 0.5% of GDP. Moreover, environmental tax revenues represented a smaller percentage of GDP in 2022 than they had in 2015 in the large majority of countries in the region.

Figure 4
Environmental tax revenues in Latin America and the Caribbean, 2015 and 2022
(Percentages of GDP)



Source: Prepared by the authors, on the basis of Organisation for Economic Co-operation and Development (OECD) and others, *Revenue Statistics in Latin America and the Caribbean 2024*, Paris, 2024; OECD Data Explorer [online] http://oe.cd/ds/ertr.
Note: The data for Argentina and Costa Rica are for 2021. The average shown for the region as a whole is the simple average of the figures for the countries listed in the figure.

The introduction of taxes designed to help protect the environment has been no easy task. Concerns about the potentially regressive effects of this type of policy tool and its ramifications in terms of the competitiveness of the economy have made it difficult to reach the type of consensus that would facilitate the acceptance of green taxes and support their political viability. The "tragedy of the horizon" (Carney, 2015), that is, the ascendency of the short term over the long term in economic and financial matters, is the most obvious reason for the unsustainability of the existing development process.

The fact that the Latin American and Caribbean region's development style tends towards unsustainable production and consumption patterns is a cause of concern. Because these patterns are based on a positive relationship between economic growth, energy consumption and emissions, the growth of household income is closely linked to energy consumption as well, which means that it is also closely linked to CO_2 emissions and will continue to be so unless investment in renewable energy sources is significantly increased in order to radically alter the energy matrix.

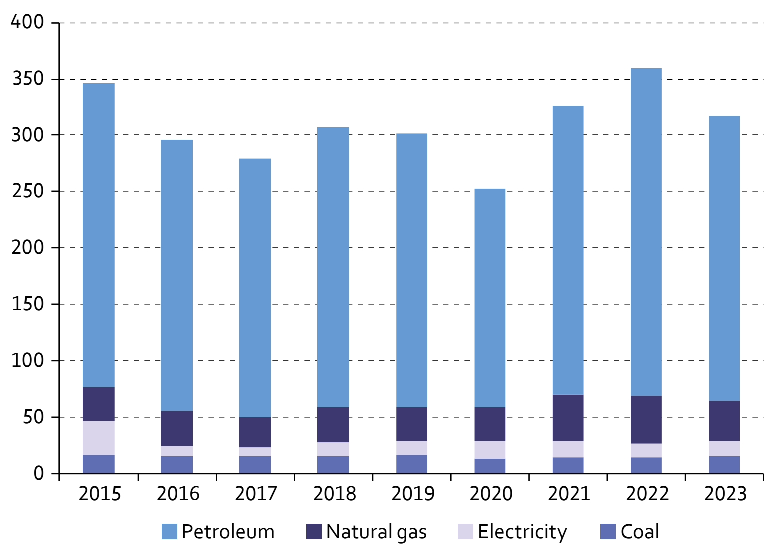
The region is also highly urbanized, with 80% of the population residing in urban areas. The increased number of people living in cities generates a greater demand for transportation and, in a region where public transportation services are inefficient, this translates into a higher motorization rate, with the majority of the increase in vehicle use corresponding to privately owned automobiles. The increase in the number of motor vehicles goes hand in hand with an increase in petrol consumption, which in turns generates an entire range of externalities, including increased emissions of greenhouse gases and pollutants that harm people's health, a greater number of road accidents and declining productivity owing to the longer commute times caused by traffic congestion. Given these patterns in the region, the prices of energy sources such as petrol should incorporate the actual costs that they generate, which include not only their production cost but also the social cost of the damage that they cause.

B. Fuel subsidies

The consumption of fossil fuels (chiefly petroleum and coal) is unquestionably the most significant anthropogenic factor at the global level in the generation of greenhouse gases and, hence, in climate change (Molina, Sarukhán and Carabias, 2017). Consequently, in order to achieve the goals of the Paris Agreement, the world needs to stop relying on the production and consumption of fossil fuels as its main energy source. A substantial number of countries around the world have committed to achieving net zero emissions by 2050; in order to limit the rise in global temperatures to 1.5°C, emissions will need to be reduced by 43% by 2030 (UNFCCC, 2023), which will entail major reductions in the use of fossil fuels (coal, petroleum and natural gas).

In order to make headway towards global climate action goals, economic incentives and regulatory frameworks will be needed that will boost investment in a sustainable transformation of production patterns. Carbon pricing, along with reductions in fossil fuel subsidies, is a means of promoting low-carbon development options and helping to mobilize financing for the climate transition (OECD, 2021). According to the High-Level Commission on Carbon Prices, the reduction and elimination of fossil fuel subsidies is an essential step towards carbon pricing, since, in effect, such subsidies are tantamount to a *negative* emissions price. (Stern and Stiglitz, 2017). Yet, at the world level, fossil fuel subsidies totalled US$ 6.5 trillion in 2023, or 6.5% of global GDP (Black and others, 2023). This means that, for every dollar pledged for the mitigation of the effects of climate change, US$ 65 went to fossil fuel subsidies. The Latin American and Caribbean region has also made extensive use of fossil fuel subsidies. In 2023, the region spent US$ 317 billion on such subsidies (see figure 5), or 5.4% of its GDP; 80% of those subsidies were for petroleum and another 12% were for natural gas.

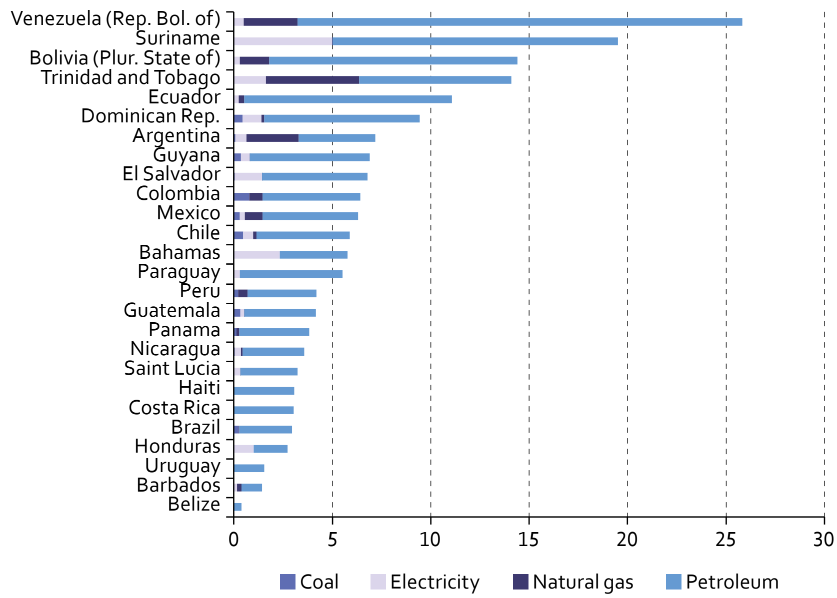
Figure 5
Latin America and the Caribbean: fossil fuel subsidies, 2015–2023
(Billions of dollars at constant 2021 prices)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023.

Continuing to subsidize fossil fuel consumption not only runs entirely counter to the objectives of the Paris Agreement but is also a major drain on public finances. The resources allocated for fossil fuel subsidies have a high opportunity cost, since they could otherwise be used to fund social (education, health, housing) policies, infrastructure and investments in means of coping with the challenges of climate change. The countries of the region that spent the most, as a percentage of GDP, on fossil fuel subsidies in 2023 were the Bolivarian Republic of Venezuela, Suriname, the Plurinational State of Bolivia, Trinidad and Tobago, and Ecuador (see figure 6).

Figure 6
Fossil fuel subsidies as a percentage of GDP, 2023
(Percentages)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023.

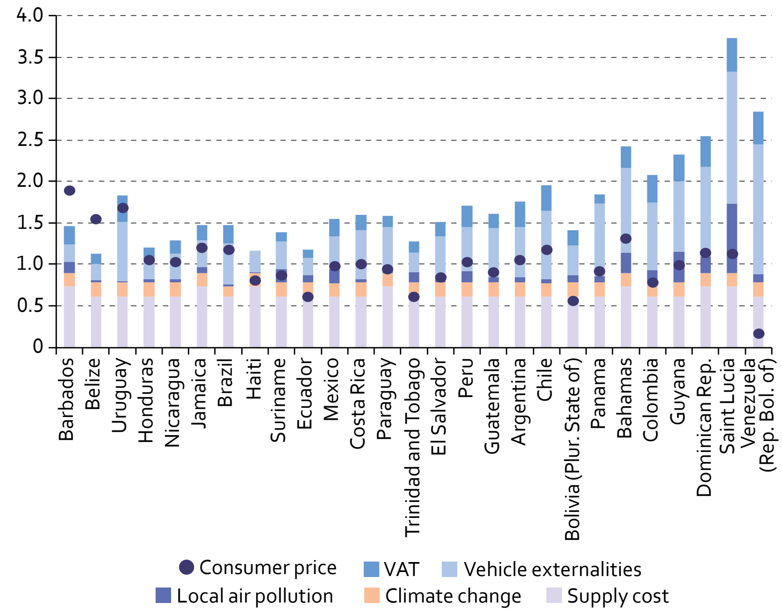
The market prices of fossil fuels in the region, as well as in many other countries, are inefficient because they do not reflect the true social costs of their use (the costs associated with climate change, the deterioration in air quality and numerous other externalities). In addition, fossil fuel subsidization policies are inequitable given the structure of fuel (especially petrol) consumption, which is sharply skewed towards the higher income deciles. In essence, then, the subsidization of fossil fuel use is equivalent to a monetary transfer to higher-income households.

Given the situation with respect to fossil fuel subsidies in the region, there is an urgent need for the introduction of an efficient fuel pricing policy that will include the actual costs of their use rather than only their production cost. Figure 7 depicts what efficient petrol prices (PE_P) would look like for the countries of Latin America and the Caribbean, which, according to Black and others (2023), is given by:

$$EP_P = (SC + EC) * (1 + CTR, \text{ if applicable}) \quad (1)$$

where (EP_P) is the economically efficient price for petrol, *SC* is the unit supply cost, *EC* is the unit environmental cost and *CTR* is the general consumption tax rate. (The price of petrol refers only to highway fuel usage here.) In addition to the supply costs, the calculations take into account the environmental costs, which include the costs associated with climate change, air pollution and other vehicle use externalities, such as road accidents, traffic congestion and road wear and tear. They also take into account the cost of forgone tax revenues.

Figure 7
Efficient petrol prices in Latin American and Caribbean countries
(US$ per litre)



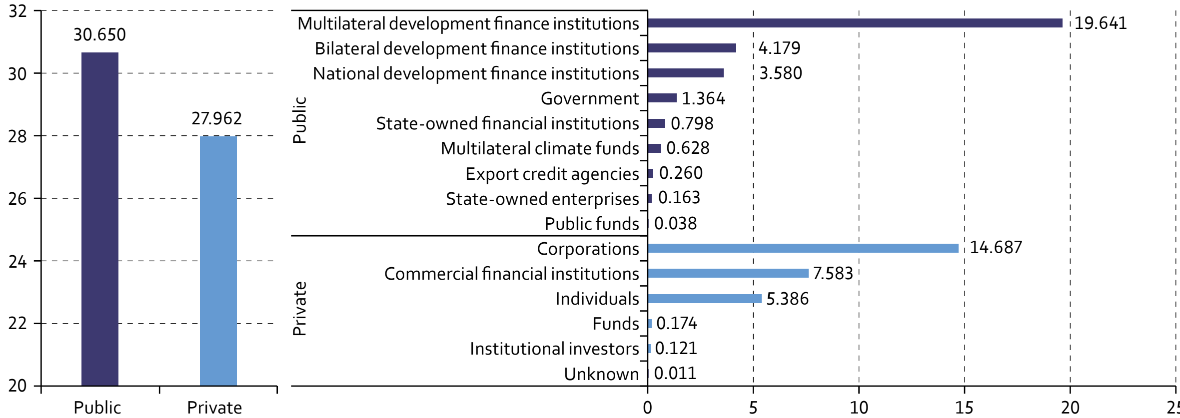
Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023.
Note: VAT: value added tax; vehicle externalities include the costs associated with traffic congestion and road accidents.

Efficient pricing calculations indicate that only two countries have set retail petrol prices at levels above the supply cost plus the social costs of environmental pollution. There are a group of countries in which the efficient price is at least twice as high as the price charged to the public, and there are three countries in which that price does not even cover the supply cost. Many other countries have retail prices that do cover supply costs and the general petrol tax but do not cover the social costs of climate change and air pollution. These results demonstrate the necessity of reforming fossil fuel subsidization policies. This subject will be dealt with in greater detail in a later section of this study.

C. Climate finance

One of the challenges involved in speeding up the pace of climate action in developing countries is finding ways of financing the investments needed to meet the adaptation and mitigation targets proposed in their NDCs and long-term strategies. According to the *Climate Policy Initiative*, climate finance in Latin America and the Caribbean amounts to just 4.1% of global climate finance. During 2022, finance for climate action in the region came to US$ 58.6 billion, with that sum being almost equally split between public and private sources (see figure 8). Development finance institutions provided 89% of the climate action funding supplied by public sources, while commercial financial institutions and corporations accounted for 79% of the private funding.

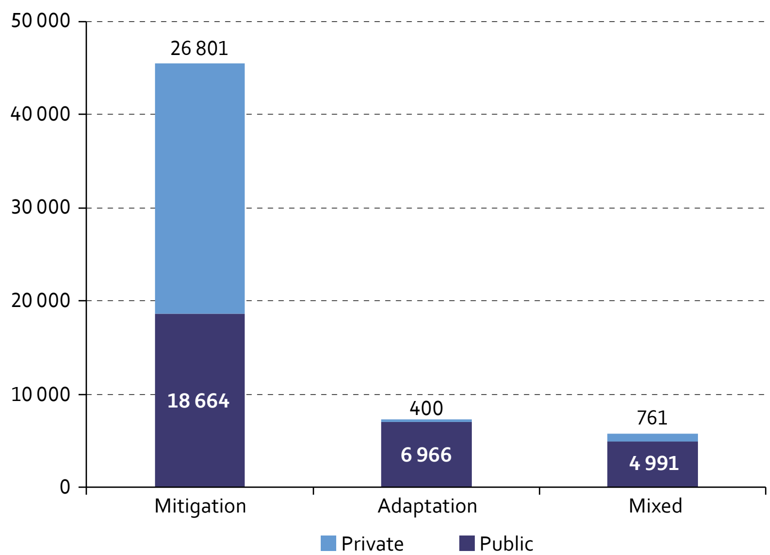
Figure 8
Public and private sources of climate action financing in Latin America and the Caribbean, 2022
(Billions of dollars)



Source: Prepared by the authors on the basis of Climate Policy Initiative (CPI), Global Finance Tracking, 2024 [accessed on 17 April 2024].

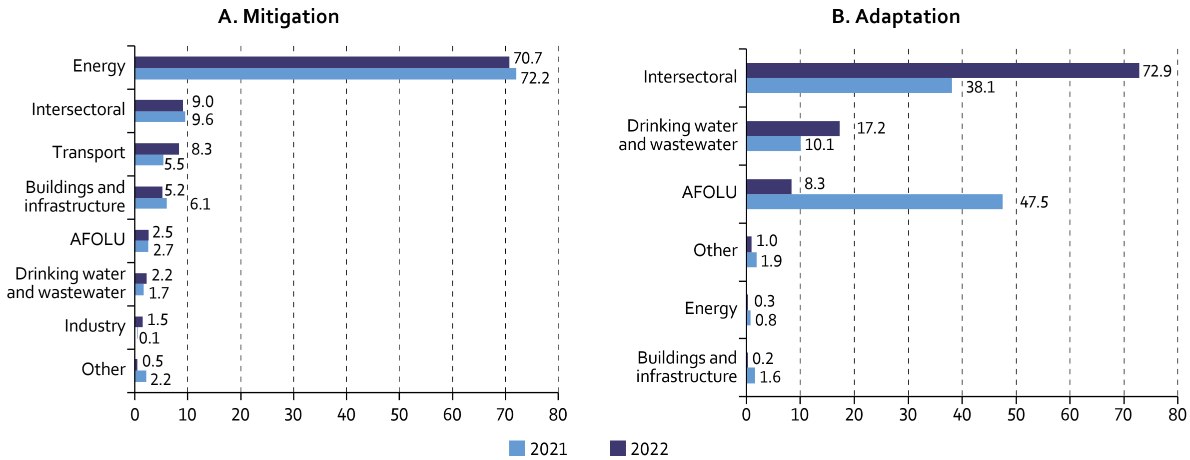
There continues to be a sharp imbalance in the uses of climate finance at both the world and regional levels. In Latin America and the Caribbean, slightly more than three fourths of climate action finance is allocated for mitigation, while much less is used for adaptation to changing climatic conditions and for mixed (combined mitigation and adaptation) measures (see figure 9). The priority that the countries have placed on the energy sector for fulfilling the emissions reduction commitments made in their NDCs is reflected in the volume of finance directed to that sector (70%). The fact that the sector of renewable energy sources is an attractive one for investors also plays a role in this connection. In the case of financing for adaptation measures, 73% was channelled into intersectoral forms of action (see figure 10).

Figure 9
Climate action finance in Latin America and the Caribbean in 2022, by use and by public/private source
(Millions of dollars)



Source: Prepared by the authors, on the basis of Climate Policy Initiative (CPI).

Figure 10
Sectoral shares of financing for mitigation and adaptation in Latin America and the Caribbean, 2021–2022
(Percentages)



Source: Prepared by the authors, on the basis of Climate Policy Initiative (CPI), Global Finance Tracking, 2024 [accessed on 17 April 2024].
Note: AFOLU = agriculture, forestry and other land use.

In a recent study, ECLAC estimated the investment required to meet the climate action targets set out by the countries of the region in their NDCs at between US$ 215 billion and US$ 284 billion up to 2030 (ECLAC, 2024). According to those same estimates, an accumulated investment of between US$ 2.1 trillion and US$ 2.8 trillion will be needed between 2023 and 2030, which is equal to an average of between 3.7% and 4.9% of the region's GDP each year. The greatest need for investment is for mitigation, particularly in order to modernize transport systems and transition to more sustainable forms of transportation. Many countries have defined goals and plans for transitioning to electric vehicles.

In order to meet these needs for financing and close the funding gap, new sources of resources will have to be found in order for each country to be able to carry out the investments it sees as being key to the transition to low-carbon economies, in which both private and public actors have an extremely important role to play. Finding these new sources of finance will involve the use of carbon pricing in the countries that are not yet implementing it or the upward adjustment of those prices to incorporate GHG emissions externalities. Green bonds are another promising source of climate financing and will be explored in the following section.

D. Green bonds and sustainable taxonomies

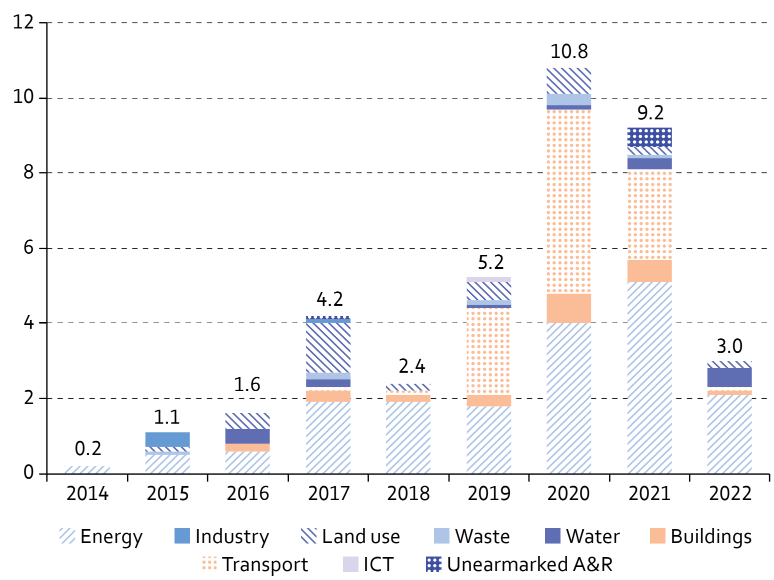
In order to speed up the transition to carbon neutrality and increase their economies' resilience, the countries are devising climate action financing strategies. Some of the novel devices in their toolkits which are already in widespread use are green bonds and sustainability bonds (Velloso, 2023). In order to design green bonds, finance ministries must work in coordination with environmental ministries and the financial system. Over the last decade, climate action finance in Latin America and the Caribbean has involved a growing share of funding from multilateral development banks and from climate-targeted bonds, while the share of funding from national development banks has declined (Samaniego and Schneider, 2023).

The green bond market is more or less a newcomer on the world stage, having first been used by the multilateral development banking system in 2007 to finance projects designed to address the challenges posed by climate change. But the global green bond market, in which European countries are very active participants, has grown rapidly in recent years, expanding at an average annual rate of 38% between 2014 and 2022. The Latin American and Caribbean region has also seen rapid growth in green bond issues but, but the region's issues still represented only 1.7% of the world market for those securities in 2014–2022.

Given the sluggish growth of the Latin American and Caribbean economies in recent years, green bonds can prove to be useful tools for policymakers working on the design of stimulus programmes and investment financing schemes that will help to galvanize economic activity while at the same time helping to finance projects aimed at achieving climate action goals and forging more sustainable development styles. Because these bonds incorporate tracking mechanisms that afford greater transparency and accountability, they can also lead to improved forms of financial management as well as helping to bring about the necessary changes in the region's production patterns.

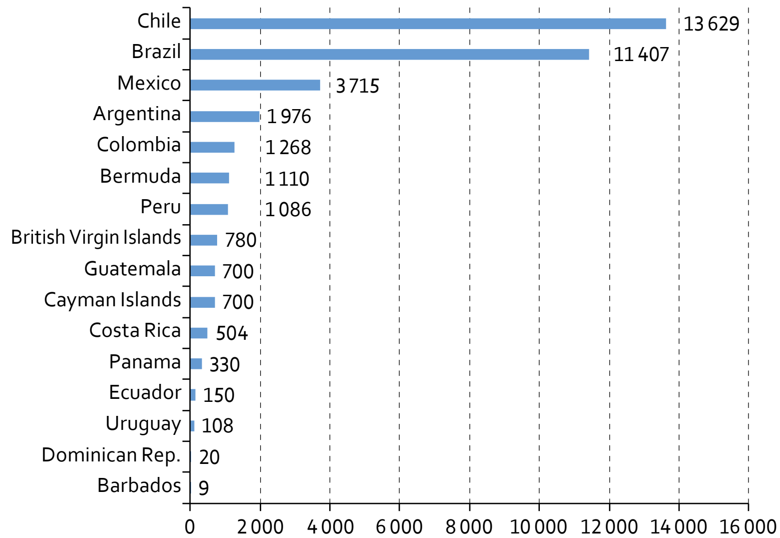
The green bond market started up in Latin America and the Caribbean in 2014 and, to date, 16 of the region's 33 countries have issued green bonds. Between 2014 and 2022, the regional green bond market totalled US$ 37.7 trillion (see figure 11); a full 67% of those issues were conducted by Chile and Brazil (see figure 12). The prevailing conditions in this growth market for the region have enabled some countries to issue bonds at a discount, which lowers the borrowing costs for these issuers. The difference between the yields of green bonds and conventional bonds issued by a similar entity is known in the literature as a "green premium" (Tang and Zhang, 2020; MacAskill and others, 2021). This has been the case of bond issues conducted by Chile and Peru.

Figure 11
Latin America and the Caribbean: trend of the green bond market and use of bonds, by sector, 2014–2022
(Billions of dollars)



Source: Prepared by the authors, on the basis of Climate Bonds Initiative.
Note: "Unearmarked A&R" refers to the sums for adaptation and resilience that have not been earmarked for other sectors.

Figure 12
Latin America and the Caribbean: cumulative green bond issues, by country, 2014–2022
(Millions of dollars)



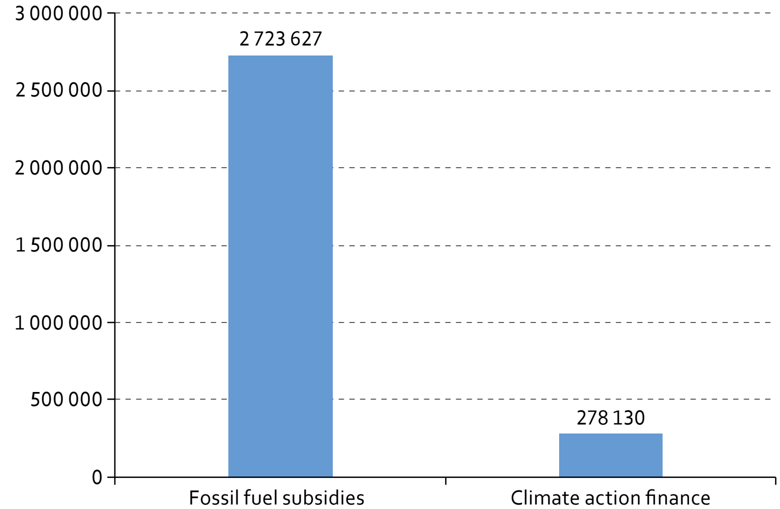
Source: Prepared by the authors, on the basis of Climate Bonds Initiative.

The use of green bonds varies markedly from one country to the next, with the main institutional issuers of such bonds being private financial and non-financial corporations. Since 2019, sovereign bond issues have also accounted for a substantial share of this market in the region. The use of the funding provided by green bonds has also been quite diverse in recent years. Ever since green bonds began to be issued in the region, a large share of these investments have been channelled into the energy sector, but between 2019 and 2021, the transport sector also attracted a significant amount of long-term investments financed by green bonds. In 2020 and 2021, 82% of the allocations of green bond funds in the region were channelled into the energy and transport sectors for renewable energy and sustainable mobility projects (see figure 11).

Sustainable finance taxonomies are another policy tool for promoting investments in sectors that will contribute to progress towards climate action goals. These taxonomies provide information that helps to guide financing towards sectors and activities that are aligned with the Sustainable Development Goals and the Paris Agreement (UNEP, 2023). They can be another way of helping to green the financial system, but they can also serve as a transformational industrial policy instrument for leveraging the competitiveness of emerging markets in carbon-neutral societies. In Latin America and the Caribbean, Mexico, Colombia and, more recently, Panama have already developed taxonomies to align public and private investment with low-carbon, climate-resilient sectors and activities. Other countries, such as Argentina, Brazil, Chile, Dominican Republic and Peru, are well on their way to establishing similar taxonomies, and there are a number of other countries that have started to develop them.

These taxonomies are a necessary component of sustainable financial markets, but they do not in themselves speed up or intensify the transition towards such markets. In order to do that, steps need to be taken to create and reinforce a conducive policy environment. This is because, despite the dynamism of climate action financing and the use of innovative instruments to promote it in the region, there is still a lack of coordination and consistency between climate policies and objectives, on the one hand, and energy, agricultural and transportation policies (and, in particular, the fossil fuel subsidies that they provide), on the other. The data on climate action finance and on fossil fuel subsidies for Latin America and the Caribbean indicate that, for each dollar invested in climate action between 2013 and 2022, US$ 9.8 was spent on subsidies for fossil fuel use (see figure 13).

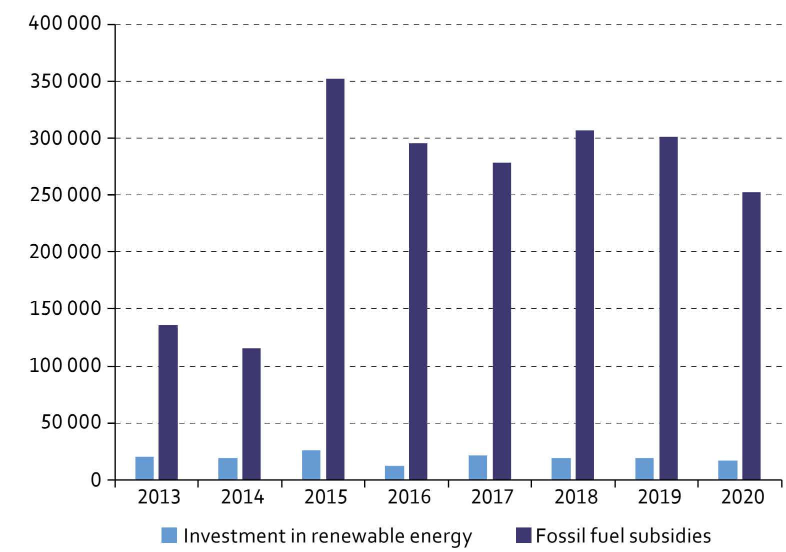
Figure 13
Fossil fuel subsidies versus climate action finance in Latin America and the Caribbean (totals), 2013–2022
(Millions of dollars at constant 2021 prices)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023; International Institute for Sustainable Development/ Organisation for Economic Co-operation and Development (IISD/OECD), Fossil Fuel Subsidy Tracker [online database] https:// fossilfuelsubsidytracker.org/; J. Samaniego and H. Schneider, "Quinto informe sobre financiamiento climático en América Latina y el Caribe, 2013-2020", *Project Documents* (LC/TS.2023/85/REV.1), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2023; and Climate Policy Initiative (CPI).

Similarly, investment in renewable energy sources in the region has fallen short of expectations and of what is needed to contribute to the decarbonization of the region's economies. The huge sums spent each year on subsidy-driven fossil fuel consumption and production are making it that much more difficult to limit the increase in global temperatures to 1.5°C. In fact, in comparative terms, Latin America and the Caribbean spent 13.3 time as much on fossil fuel subsidies in 2013–2020 as it did on investments in renewable energy (see figure 14).

Figure 14
Investment in renewable energy versus fossil fuel subsidies in Latin America and the Caribbean, 2013–2020
(Millions of dollars at constant 2021 prices)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023; International Institute for Sustainable Development/Organisation for Economic Co-operation and Development (IISD/OECD), Fossil Fuel Subsidy Tracker [online database] https://fossilfuelsubsidytracker.org/; International Renewable Energy Agency/Climate Policy Initiative (IRENA/CPI), *Global Landscape of Renewable Energy Finance*, Abu Dhabi, 2023.

These data make it all the more evident that economic (fiscal and investment) policies are urgently needed that will help the countries to transition to more productive, inclusive and low-emissions economies. In order to accomplish this, changes in relative prices will be needed, along with the reform of fossil fuel subsidies and the generation of price signals that alter the yields of investments in a way that makes low-carbon investments more attractive. Finance ministries have a fundamental role to play in all of these changes in public policy, and it is essential that they work in coordination with environmental, energy-sector and banking authorities. The region's finance ministries have been working in these areas on an individual basis and collectively through the Coalition of Finance Ministers for Climate Action, the Regional Climate Change Platform of Economy and Finance Ministries of Latin America and the Caribbean, the Network of National Public Investment Systems of Latin America and the Caribbean (RedSNIP) and the Council of Finance Ministers of Central America, Panama, and the Dominican Republic (COSEFIN). It is to be hoped that this collective effort and the ministries' shared experience in these forums will help the countries of the region to make rapid progress on a coordinated basis towards bringing about the policy changes needed in order to address the challenges posed by climate change.

III. Carbon pricing in Latin America and the Caribbean

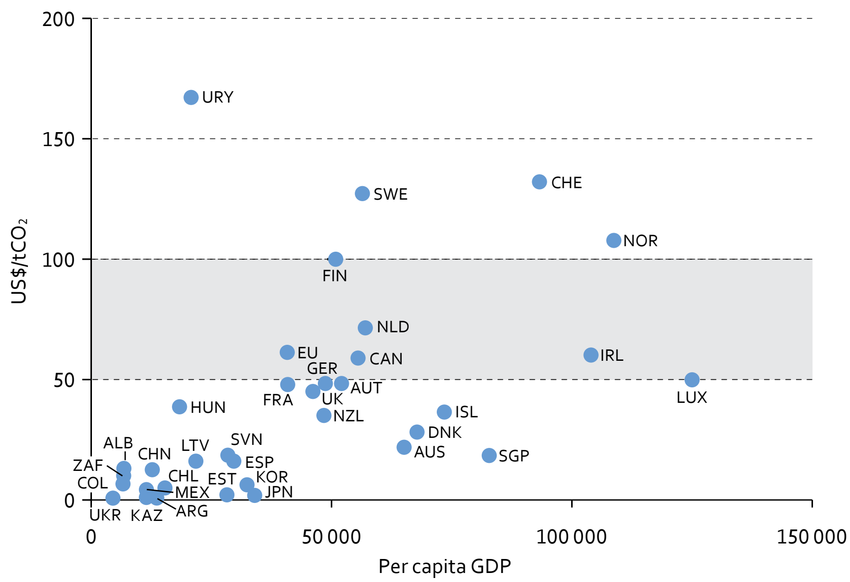
From an economic standpoint, GHG emissions are a negative externality (Stern, 2007), and the inefficiencies associated with emissions can therefore be corrected by sending the right price signals. There are various ways to go about pricing carbon. One way is to do so explicitly by levying a carbon tax or using an emissions trading system (ETS). Another is to embed notional prices in financial instruments and incentives to foster low-carbon projects (Stern and Stiglitz, 2017).

Carbon pricing tools offer the advantage of not only inducing changes in the behaviour of emitters but also generating some of the income needed to finance the transition to low-carbon economies. The funds obtained from carbon pricing systems can be used to finance many of the activities involved in a decarbonization strategy, such as the promotion of more equitable growth, compensation for population groups that are impacted in undesirable ways, technological change and investment in sustainable infrastructure that is compatible with climate change scenarios, among others. Carbon pricing instruments are therefore a fundamental part of national strategies for reducing emissions and building more resilient societies.

Carbon pricing policies are, generally speaking, more cost-effective than regulations or subsidies in cutting emissions (Gugler, Haxhimusa and Liebensteiner, 2021; IPCC, 2022), and if the price is set correctly, it will internalize the social cost of emissions externalities, thereby creating economic incentives for lowering emissions to a socially optimum level (Baumol and Oates, 1988). Various analyses and recommendations concerning carbon pricing can be found in the international literature. According to the High-Level Commission on Carbon Prices when its members met in 2017, the explicit carbon price that would be consistent with achieving the Paris Agreement temperature target was at least US$ 40 US$ 80/tCO_2 in 2020 and would be US$ 50 US$100/t$CO_2$ by 2030 (Stern and Stiglitz, 2017). This price range is similar to the carbon prices suggested by IPCC in its *Sixth Assessment Report*, where it stated that the price should be between US$ 60/tCO_2 and US$ 120/tCO_2 in order to limit global warming to 2°C by 2030 and between US$ 170/tCO_2 and US$ 290/tCO_2 in order to hold the temperature increase to 1.5°C (IPCC, 2022).

The International Monetary Fund (IMF) has proposed an international carbon price floor for countries that are large emitters. In one of its pricing scenarios, it posits that advanced economies are subject to a price floor of US$ 50/tCO_2 and, in another, that advanced countries would be subject to a price floor of US$ 75/tCO_2, while middle-income countries' price floor would be US$ 50/tCO_2 and low-income economies would have a floor of US$ 25/tCO_2 (Parry, Black and Roaf, 2021). Figure 15 plots out carbon prices for different countries in relation to their incomes as a percentage of per capita GDP. As may be seen from the figure, only a small proportion of carbon prices are within the price range that is consistent with the Paris Agreement targets.

Figure 15
Carbon prices around the world
(Dollars per ton of CO_2 and US$ PPP as of 2018)



Source: Prepared by the authors, on the basis of World Bank, "State and Trends of Carbon Pricing Dashboard" [online] https://carbonpricingdashboard.worldbank.org/compliance/price; World Development Indicators [online database] https://databank.worldbank.org/source/world-development-indicators.

Despite what was said earlier about, in theory, carbon pricing being the best way of dealing with GHG emissions externalities, the implementation of carbon pricing systems is actually so complex that they cannot be relied on as the only public policy tool for achieving the Paris Agreement targets. An entire policy package will be needed, along with enabling environments, institution-building, technical capabilities and financing for investments in the development of new sectors to lead the transition from the traditional development style to one that is more sustainable and compatible with the natural world.

The advantages of carbon pricing systems include the internalization of GHG emissions costs, reductions in emissions and the generation of resources to help cover national operational requirements and to finance social programmes. Those resources can also be used to fund climate action, especially action relating to technological changes that will speed up the penetration of clean energy sources and the introduction of modern, sustainable transport systems, among others. Arguments against the use of carbon pricing systems include those based on concerns about potential distributional effects, loss of competitiveness, and impacts on the job market and on economic growth, all of which could undermine the political viability of their implementation.

One way of making carbon pricing systems' implementation more feasible is to take their potential regressive effects into account when designing them. There is evidence that the effect of motor vehicle taxes is neutral or progressive, whereas taxes on energy sources are more likely to be regressive (Sterner and Coria, 2012; Flues and Thomas, 2015). this is because an increase in energy costs caused by the introduction of a tax will represent a larger proportion of the expenses of low-income households (Dorband and others, 2019; Ohlendorf and others, 2021), and it is therefore both necessary and socially desirable for policymakers to consider ways of compensating households and/or businesses that are strongly affected by such increases. Table 1 gives some examples of ways of lessening the undesired impacts of carbon pricing.

Table 1
Examples of means of addressing adverse impacts of carbon taxes

Type	Compensatory measures
Tax reduction measures	• Exemptions • Reduced rates • Tax rebates • Offsets
Support measures	• Support for efficient resource use and cleaner production processes • Production-based reimbursements • Set payments • Reduction of broad-based non-carbon taxes
Trade-related measures	• Carbon border adjustment mechanisms (CBAMs) • Consumption-based taxation • International cooperation

Source: Prepared by the authors, on the basis of United Nations, *United Nations Handbook on Carbon Taxation for Developing Countries*, New York, 2021.

It is also important to consider the element of graduality in the implementation of a carbon tax, along with long-term certainty, in order to bolster the deployment of sectoral policies that will help to increase the availability of alternatives or substitutes. With regard to concerns about the potential impacts of carbon prices on GDP, the evidence indicates that the results may vary and depend to some degree on the decisions made about how tax revenues should be used. The design of the carbon pricing system can incorporate methods of recycling tax revenues in order to reduce the impact on factors of production (capital and labour). This could spur economic activity, create jobs and make the double dividend of carbon pricing a reality (Ekins and Speck, 2011).

A. Carbon taxes in Latin America and the Caribbean

In theory, carbon taxes (like any other environmental tax) should be set at the level of the marginal social cost of the damage caused (commonly referred to as the social cost of carbon). Determining the cost of the damage caused by climate change is technically challenging, however. In addition, its marginal social cost is global in nature, whereas the cost of reducing emissions is local. Consequently, the optimum tax level at the global level may be considerably higher than the level that a given jurisdiction (country, region) can afford to pay (United Nations, 2021).

National and local circumstances need to be taken into account in the design of carbon taxes as well as in all other climate-related policies. In order to determine the size of the carbon tax, governments take such aspects into consideration as emissions reduction commitments made in their NDCs, competitiveness, distributive impact, consistency with other policy instruments and, above all, political viability (Pizarro, 2021). This is why carbon prices vary so much from one country to the next. The use of carbon taxes is still at an early stage in Latin America and the Caribbean, although it was first introduced in 2014. Only five countries in the region —Mexico, Chile, Colombia, Argentina y Uruguay— have a carbon tax at this point. Their carbon tax systems will be briefly described below.

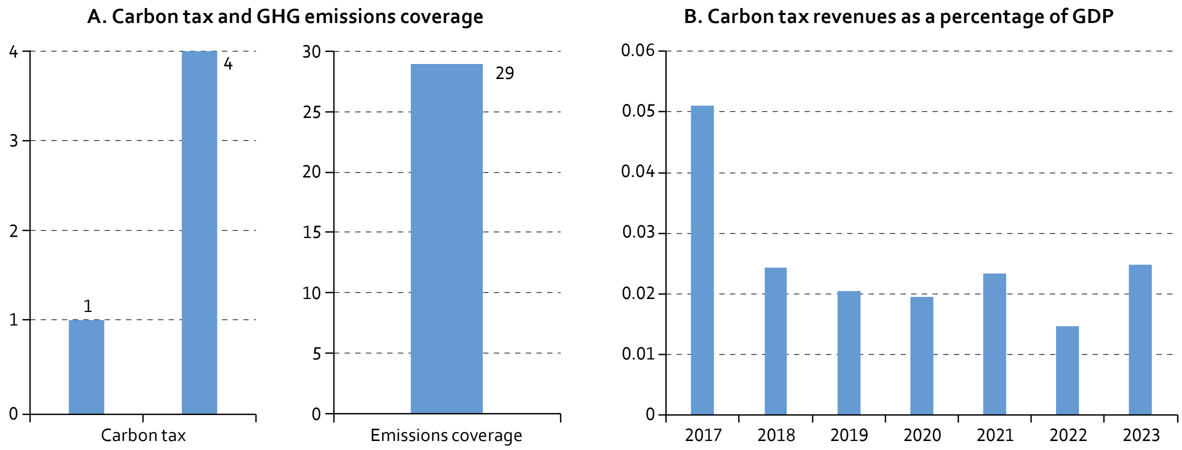
1. Mexico's carbon tax

Mexico was the first country in the region to introduce a carbon tax. In January 2014, it began to apply a variant of its production and services excise tax on the carbon content of fossil fuels. Strictly speaking, the tax is not levied on the total carbon content of fuel but rather on the additional CO_2 emissions from fuels over and above those produced by natural gas[1] (World Bank, 2021). Mexico is using this tax as a disincentive for the consumption of fossil fuels other than natural gas and as a means of helping to reduce GHG emissions enough to honour its NDC commitments.

[1] In March 2022, the Ministry of Finance and Public Credit of Mexico announced that, as a fiscal stimulus measure, petrol and diesel fuel would be exempt from the carbon tax until 31 December 2024.

This carbon tax applies to production, imports, purchases and sales of fossil fuels (propane, butane, petrol, avgas, aviation turbine fuel, kerosene, diesel, fuel oil, petroleum coke, coal coke, coal and other fossil fuels) that are to be used in combustion processes with the exception of natural gas (Government of Mexico, 2021). This is an upstream tax whose level is, by law, determined on the basis of the carbon content of each type of fuel and ranges from approximately US$ 1 to US$ 4/tCO_2eq (see figure 16).[2] It covers around 29% of all of Mexico's GHG emissions and has a ceiling of 3% of the sale price (World Bank, 2024), which is low by international standards.

Figure 16
Mexico's carbon tax, emissions coverage and tax revenues, 2017–2023
(Dollars per ton of CO_2 equivalent and percentages)



Source: Prepared by the authors, on the basis of Ministry of Finance and Public Credit of Mexico.

In 2017 the Ministry of Finance and Public Credit of Mexico established an optional procedure for paying carbon taxes with certified emission reductions (CERs) issued by the United Nations Clean Development Mechanism. Under that procedure, CERs could be used to pay up to 20% of the total tax for projects carried out in Mexico (Government of Mexico, 2017). In 2019, that limit was done away with, so now it is possible to use CERs to pay the entire tax (Mexico, 2022).

Revenues from this tax are channelled into the general budget and are not earmarked. In 2023, the carbon tax brought in US$ 444.7 million in revenues, which was a 73.6% increase in real terms over the 2022 revenues from that tax but still represented only 0.17% of total tax revenues (SHCP, 2024) and 0. 024% of GDP (see figure 16).

The case of carbon pricing in Mexico is an interesting one. Carbon taxes in other countries of the region are implemented at the national level but, in Mexico, carbon taxes are also being levied by the states of Durango, Guanajuato, Estado de Mexico, Querétaro, Tamaulipas and Yucatán. In a number of cases, the state carbon tax rates are much higher than the national tax rate. The State of Querétaro has a carbon tax rate of US$ 36/tCO_2eq, and the revenues of that levy are used to fund infrastructure and environmental projects. Table 2 provides an overview of state carbon taxes in Mexico.

[2] The carbon tax rate varies depending on the type of fuel as some fuels have a higher carbon content than others, resulting in prices ranging between US$ 1 and US$ 4/tCO_2e.

Table 2
Mexican state carbon taxes

State	Year introduced	Tax base	Tax rate (US$/t$CO_2$eq)	Flex mechanism	Use of revenues
Durango	2022	Fixed sources CO_2, CH_4 y N_2o	6.04	To be determined	To be determined
Guanajuato	2023	Fixed sources CO_2, CH_4, N_2O, HFC, PFC, CN	2.72	20% fiscal incentive, price thresholds and use of natural gas	Priority uses are for environmental and economic improvement projects
Estado de Mexico	2022	Non-federal fixed sources CO_2, CH_4, N_2O	3.50	None	Activities that support a healthy environment
Querétaro	2022	Fixed sources CO_2, CH_4, N_2O, HFC, PFC, SF6	36.70	Offsets for up to 20%, fiscal stimulus	Infrastructure works and environmental projects
Yucatán	2022	Fixed sources over 500 t CO_2e CO_2, CH_4, N_2O, HFC, PFC, SF6	17.69	Fiscal stimulus measures for emissions avoidance, reductions or capture	Activities that support human health and a healthy environment
Zacatecas	2017	Fixed sources CO_2, CH_4, N_2O, HFC, PFC, SF6	15.09	None	Priority uses are for environmental and economic improvement projects

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, "State and Trends of Carbon Pricing Dashboard" [online] https://carbonpricingdashboard.worldbank.org/compliance/price; Mexican Carbon Platform (MÉXICO2), "Impuestos al carbono en México: desarrollo y tendencias", Mexico City, 2022.

2. Chile's carbon tax

Chile launched its carbon tax in 2017 under enabling provisions contained in its 2014 tax reform (Act 20.780). The carbon tax was originally established as part of the green taxes levied on local emissions of pollutants such as particulate matter (PM), nitrogen oxide (NOx), sulphur dioxide (SO_2) and carbon dioxide (CO_2) emissions and on fixed sources (boilers or turbines that individually or together add up to a thermal power capacity greater than or equal to 50 MWt (thermal megawatts)) that emit pollutants that contribute to climate change. As part of this reform, a green tax was also introduced for sales of new light-duty vehicles based on their fuel efficiency and nitrogen oxide emissions (Morales and García, 2020). The carbon tax in Chile is not applied to sources of emissions that are run on non-conventional renewable energy whose primary energy source is biomass.

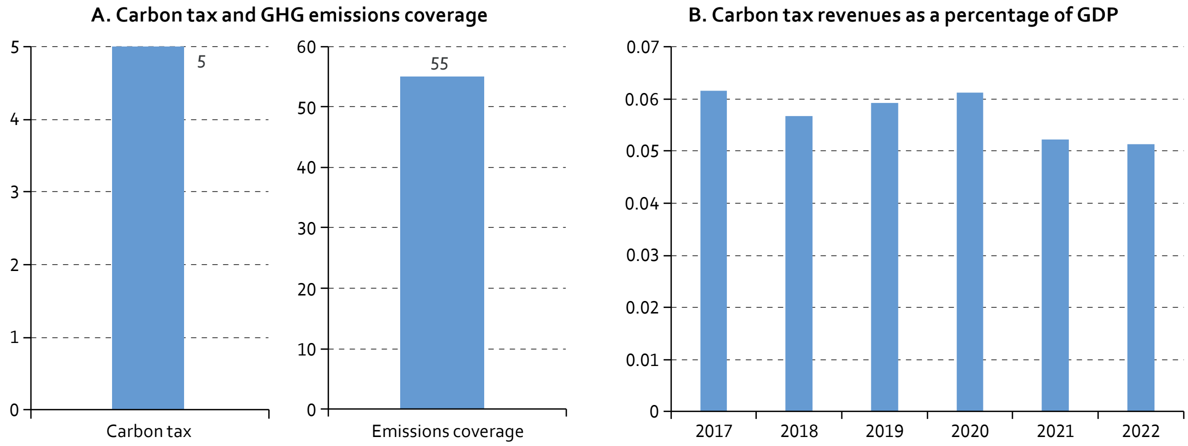
Later on, after the tax had entered into effect, design modifications were made that changed the taxable threshold from the source's thermal power capacity (boilers or turbines with a total capacity of 50 MWt or more) to a threshold of 25,000 tons of CO_2 emissions or more per year. As part of those modifications, supplementary offsets were also introduced (Pinto, 2021).

Because it is designed as a Pigouvian tax, it has a downstream regulation point,[3] and the tax rate of US$ 5 per ton of CO_2 emissions was determined on the basis of the social cost of carbon as estimated by the Ministry of Social Development. This tax, along with other policy instruments in Chile, is intended to permit the country to achieve the GHG emissions reduction target established in its NDC (to not exceed 95 Mt of CO_2eq in 2030) and its goal of reaching carbon neutrality by 2050 (Government of Chile, 2020). This carbon tax covers about 55% of Chile's GHG emissions (World Bank, 2024). Because of its low rate, this tax is a quite modest policy instrument when compared to other carbon prices used around the world and is even lower than the social price of carbon used by Chile itself to evaluate public investment options.

[3] The regulation point (the point at which a tax is charged) will depend on the fiscal approach being used. In the economic literature, at times a distinction is made between upstream, downstream and midstream regulation points. A carbon tax based on direct emissions, as in Chile's case, is a downstream tax because it is levied on the actual emissions of the facilities subject to the tax.

Chile's carbon tax revenues are channelled into the national budget and, in accordance with specific constitutional provisions, are not earmarked. In 2022, the carbon tax brought in revenues amounting to US$ 154 million, which was a 6.7% drop from their 2021 level. This sum represented 0.05% of the country's tax revenues and 0.23% of its GDP (see figure 17).

Figure 17
Chile's carbon tax, emissions coverage and tax revenues, 2017–2022
(Dollars per ton of CO_2 and percentages)



Source: Prepared by the authors, on the basis of Internal Revenue Service (SII) of Chile.

With the tax rate being as low as it is, it is to be expected that the revenues it brings in will also be low, which does not leave much fiscal space for funding social and environmental programmes and policies. A gradual increase in the carbon tax would be one way of avoiding sudden changes that would have undesirable effects on low-income groups while still helping the country to deliver on its climate action goals. In addition, by Supreme Decree No. 4 of 2023, the Ministry of the Environment of Chile approved a regulation providing for the implementation of projects to reduce emissions of pollutants as a means of offsetting emissions against the green tax. This regulation will help to spur the national carbon market by allowing owners of fixed emissions sources to undertake climate change mitigation projects as offsets.

3. Colombia's carbon tax

Colombia introduced its carbon tax in 2017 as part of a policy package aimed at discouraging the use of fossil fuels and helping it to fulfil its Paris Agreement emissions reduction commitments. The tax was authorized as part of the 2016 tax reform provided for in Act No. 1819 and was then modified in the course of the tax reform of December 2022 (Act No. 2277). The tax is applied to the first sales activity in the supply chain within Colombia, importation or own-consumption of all fossil fuels, including all petroleum products, fossil gas and solids used for combustion. At first, coal and natural gas for generating electricity were exempt from the tax but, under Act No. 2277 of 2022, coal became subject to the tax in some cases. Coal coke is still exempt, liquid petroleum gas is taxed only if it is sold to industrial users, while natural gas is subject to the tax only if it is sold to the petrochemicals or hydrocarbon refining industries[4] (Ministry of Environment and Sustainable Development of Colombia, 2024).

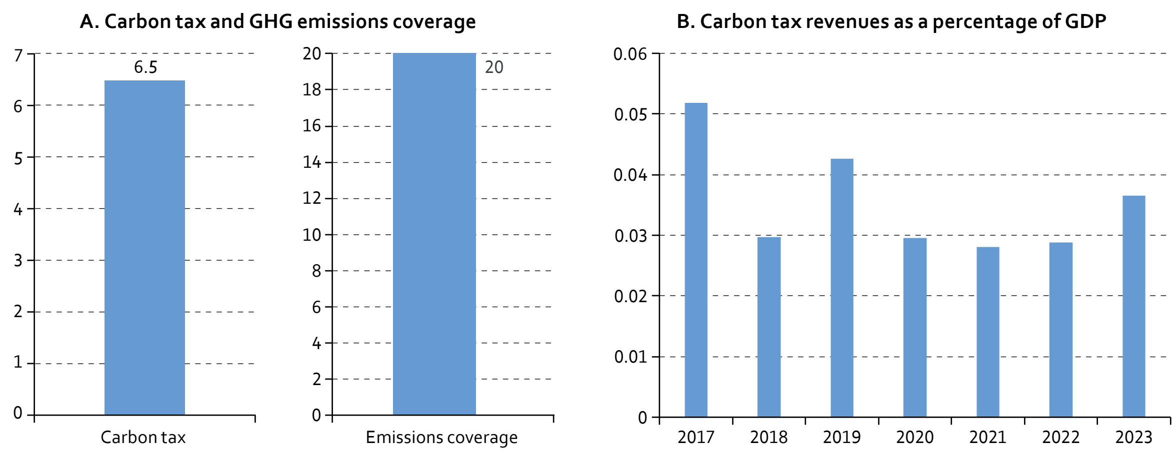
[4] Under this law, there are also exemptions for ethanol, biodiesel produced from plant material, fuels sold in the departments of Guainía, Vaupés and Amazonas, sales of marine diesel and resupplies of fuel for international shipping.

In Colombia, the carbon tax is an upstream levy and is therefore based on the carbon content of the fuel. The tax rate was set at US$ 5, but it was indexed to inflation in order to maintain the rate's price signal. Thus, it was designed to incorporate an annual adjustment for inflation plus one point until the tax rate reaches the equivalent of three Tax Value Units[5] (approximately US$ 35). The 2024 tax rate is thus Col$ 25,799 (Colombian pesos),[6] or about US$ 6.5. The carbon tax covers around 20% of GHG emissions in Colombia (World Bank, 2024).

The original design of the carbon tax allowed for offsets of up to 100% of the tax. An exemption can be obtained if a taxable entity can show that it is offsetting the GHG emissions generated by the combustion of fossil fuels subject to the tax that are to be sold, imported or used. This is done through the use of emissions reduction or GHG removal certificates (Ministry of Environment and Sustainable Development of Colombia, 2018). The percentage of the tax that can be offset was lowered to 50% in the carbon tax reform conducted under Act No. 2277 of 2022. In 2023, revenues from carbon taxes came to US$ 132.8 million, which was an increase of 33.4% over the figure for 2022 but only equal to 0.18% of total tax receipts and less than 0.04% of the country's GDP (see figure 18).

Colombia has provided for the earmarking of carbon tax revenues. By law, 80% of these funds are to go to finance climate action aimed at furthering the country's low-carbon development and measures provided for in its NDC. These funds are administered by the Sustainability and Climate Resilience Fund (FONSUREC). The remaining 20% of these revenues is channelled into the National Illicit Crop Substitution Programme (Fondo Colombia en Paz).

Figure 18
Colombia's carbon tax, emissions coverage and tax revenues, 2017–2023
(Dollars per ton of CO_2 and percentages)



Source: Prepared by the authors, on the basis of Directorate of National Taxes and Customs (DIAN) and National Administrative Department of Statistics (DANE).

4. Argentina's carbon tax

Following passage of its 2017 tax reform (Act No. 27.430), Argentina began to levy its carbon tax in March 2018. That law replaced a tax on liquid fuels and natural gas with a tax on liquid fuels and on carbon dioxide emissions, thus modifying its ad valorem tax structure with the introduction of excise or lump sum taxes in order to reflect the environmental impact of liquid fuel use based on the volume of CO_2 emissions and decoupling the per-litre tax from possible variations in the domestic price of each

[5] The Tax Value Unit (UVT) is a unit of account used to adjust the values cited in tax regulations and laws in Colombia. By resolution No. 000187 of 28 November 2023, the Directorate of National Taxes and Customs (DIAN) set the UVT at Col$ 47,065 for 2024. The average exchange rate between January and 15 May 2024 was 3,906 pesos.

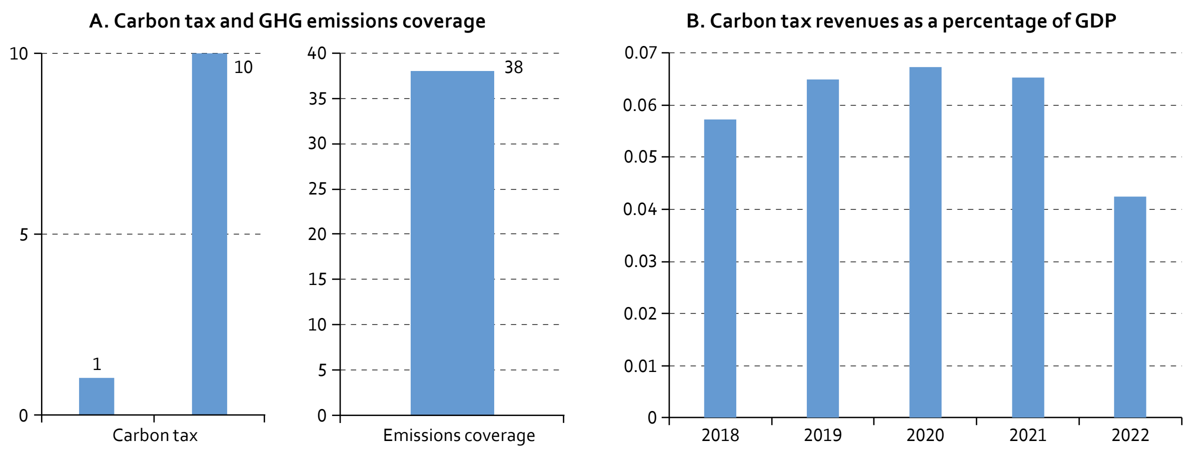
[6] Resolution 000007 of 31 January 2024 (DIAN, 2024).

taxable item (Congressional Budget Office, 2018). Argentina's carbon tax applies to a variety of liquid fuels and to solid fuels such as coal and petroleum coke in the energy, manufacturing, transport, mining, agriculture, forestry and fishery industries. The relevant law establishes that carbon taxes do not apply to pure biofuels.[7]

In order to offset the increase in fuel prices represented by the carbon tax, the government adjusted the rates of existing taxes on liquid fossil fuels. The carbon tax entered into effect on 1 March 2018 for items that were already taxes but was deferred until 2019 for items that only began to be subject to tax with the passage of the 2017 tax reform, such as fuel oil, petroleum coke and coal. The tax rate for those items started at 10% of the rate established in the law for the first year (until December 2019) and was then to be raised by 10 percentage points per year until reaching the full rate in January 2028 (Congressional Budget Office, 2018). The carbon tax on fossil fuels in Argentina ranges from 0.412 to 0.557 Argentine pesos per litre or kilo, depending on the type of fuel, which is equivalent to between US$ 1 and US$ 10 /tCO_2eq (see figure 19).

Argentina's carbon tax has an upstream regulation point, which means that, like Mexico's and Colombia's taxes, it is levied on the carbon content of the fuels in question. It covers 38% of the country's total GHG emissions (World Bank, 2024). In 2022, it brought in US$ 266.7 million in revenues, which was a 16% drop from its 2021 level and represented 0.17% of total tax revenues and 0.04% of GDP (see figure 19).

Figure 19
Argentina's carbon tax, emissions coverage and tax revenues, 2017–2023
(Dollars per ton of CO_2 and percentages)



Source: Prepared by the authors, on the basis of National Directorate of Investigations and Fiscal Analysis of the Ministry of Economy of Argentina.

Even though it is a national tax, carbon tax revenues are shared out among the different levels of government, and some portions are earmarked. Tax revenues from fuel oil are paid into the general distribution system, from which they are mainly channelled into the national treasury (42.34%) and to the provinces (54.66%). The largest share of these revenues (which comes from the carbon taxes paid on unleaded petrol of all types, virgin gasoline, natural gasoline, solvent, turpentine, gasoil, diesel oil and kerosene) goes into the special distribution system, where it is shared out among the national treasury (10.40%), the National Housing Fund (15.07%), the social security system (28.69%), the Water Infrastructure Trust (4.31%), the Transport Infrastructure Trust (28.58%), the Public Transport Compensation System (2.55%) and the provinces (10.40%).

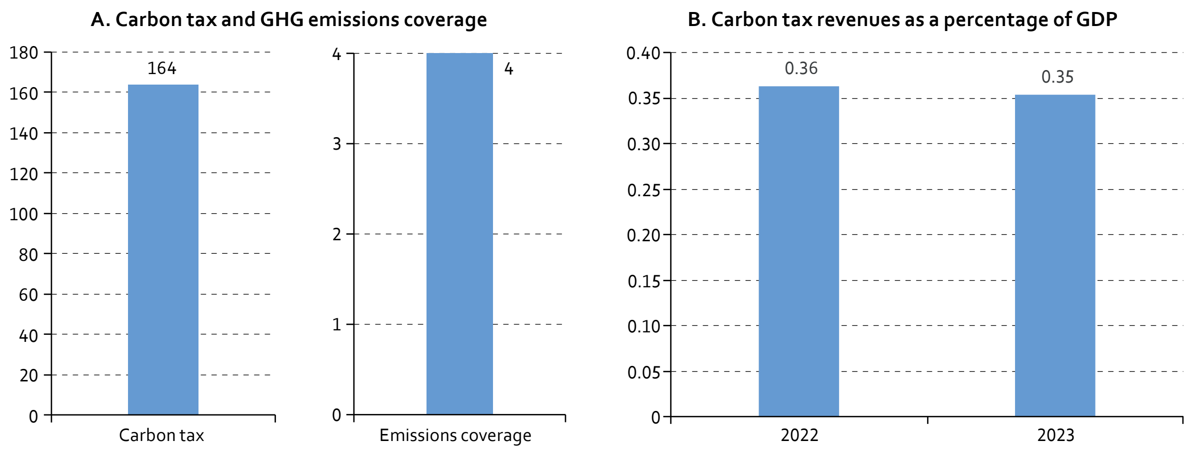
[7] Shipments of taxable fuels are also exempt if they are: (i) being exported; (ii) being used for international aviation and shipping or fishing vessels; (iii) being used as a raw material for certain types of chemical or petrochemical processing; (iv) fuel oil used for coastal shipping; or (v) being imported for end use so long as they are used by the importing agent for chemical, petrochemical or industrial processes specified in the regulations (Salassa, 2020).

5. Uruguay's carbon tax

Uruguay began to levy its carbon tax in January 2022 following the introduction of a new component in its Specific Domestic Tax (IMESI), an excise tax based on CO_2 emissions, as part of a tax reform package (Act No. 19.996 of 2021). Under the new law, the tax is levied on the first transaction carried out by manufacturers or importers of fuel (super or premium 97 grade petrol) based on tons of CO_2 emissions. Direct sales of fuel alcohol by manufacturers to industrial enterprises that produce gasoline for use as a raw material are exempt from the tax. Uruguay's carbon tax is designed to have an upstream regulation point so that it is levied on carbon content.

In 2023, the tax carried a rate of US$ 155/tCO_2. The relevant regulation establishes that the tax rate is to be updated each year based on the variation in the consumer price index and information on CO_2 emissions provided by the Ministry of Industry, Energy and Mines to the Ministry of Economic Affairs and Finance and the Ministry of the Environment. By Decree No. 449/023, these ministries updated the IMESI rate on fuels accordingly, setting the 2024 carbon tax rate at US$ 164.31/tCO_2 (see figure 20).

Figure 20
Uruguay's carbon tax, emissions coverage and tax revenues, 2017–2023
(Dollars per ton of CO_2 and percentages)



Source: Prepared by the authors, on the basis of Tax Administration Department of the Ministry of Economy and Finance of Uruguay.

Uruguay, among all the countries of Latin America and the Caribbean (and among many developed economies), is setting a precedent by establishing carbon prices at the levels that scientific evidence suggests are needed to attain the Paris Agreement targets. However, because of the way that the tax is designed, it covers only 4% of the country's GHG emissions (see figure 20). Its very limited coverage is perhaps the greatest weakness of this tax in terms of serving its purpose of cutting emissions enough to meet the country's NDC targets. In 2023, Uruguay's carbon tax generated US$ 270 million in revenues, which was slightly more (0.7%) than in 2022. Those revenues represent 0.35% of GDP (see figure 20) and 1.3% of the country's total tax receipts.

Existing laws and regulations give the executive branch the power to allocate a portion (the percentage is not defined) of the carbon tax revenues as funding for policies to promote reductions in emissions, sustainable transportation systems and the adaptation of ecosystems and production systems to the effects of climate change.

As made clear in this overview of the carbon taxes being applied by countries of the region, their tax rates are far lower than what scientific evidence indicates is needed to limit global warming to between 1.5°C and 2.0°C. Uruguay is the exception, but the carbon tax rates of Argentina, Chile, Colombia and Mexico are all around US$ 5/tCO_2. Given these circumstances, the countries of Latin America and the Caribbean might give consideration to the design of a minimum carbon tax applicable to the economies of the region. In formulating such a carbon tax, fiscal authorities would need to work in coordination with one another to determine the minimum tax rate, the tax base, the range of GHG emissions that would be covered by the tax, the potential contribution to the achievement of NDC targets, the effects of the tax on competitiveness, jobs, and GDP, its distributive impacts and the types of compensatory measures that would be used to offset its undesired effects. The proposal of a minimum carbon price and a coordinated carbon pricing response on the part of the region would help to reduce disparities, carbon leakage and the need for carbon border adjustment mechanisms, at least within the region.

B. Emissions trading systems

Emissions trading systems (ETSs) are another method of carbon pricing that can be used to reduce emissions. The permits used in these systems bestow a "right" to emit a certain volume (for example, a ton) of greenhouse gases or just CO_2 into the atmosphere. Thus, if the total volume of permits to be granted to emitters (companies, industries, countries) is known and is set at a certain level (for example, 10% below the total level of GHG emissions in 2010 by 2050), then the end result in terms of GHG emissions reductions will also be known with certainty (Truong, 2003).

These systems set a ceiling for total emissions and then distribute limited amounts of individual permits to sources of emissions in order to stay under that ceiling (the emissions reduction target). The advantage of using carbon taxes is that the cost is known (the tax itself), but the result of the tax policy in terms of emissions reductions is uncertain, whereas, with an ETS, the specific emissions reduction target to be achieved is quite clear, but the cost of achieving that reduction may not be known. There is a presumption, however, that this market-based mechanism provides a way of reducing emissions at the most cost-effective price.

Setting up an ETS involves the following main steps: (i) the ETS authority determines the total volume of emissions (for example, tons of CO_2) to be permitted in a given area (city, region, country, etc.); (ii) the authority creates the number of emissions permits corresponding to the volume of emissions decided upon in the preceding step; (iii) the authority assigns the emissions permits to the regulated agents in the defined area using a predetermined mechanism that has been announced beforehand (an auction, distribution free of charge, etc.); (iv) the area's regulated agents then buy and sell those permits based on the differentials between each agent's level of emissions and permit holdings, thereby creating an emissions market; (v) the authority then must decide on how the resources generated by the emissions trades will be used if the permits are to be sold at the start of the cycle. Thus, the ETS-based carbon pricing system allows regulated agents to engage in technological innovation and improve the efficiency of their processes, while the authorities must take up the challenge of implementing a robust monitoring, reporting and verification system.

1. Advances in Latin American countries

The region's experience in the implementation of carbon markets is still quite limited. Advances in carbon pricing have mainly had to do with the introduction of carbon taxes. So far, only one ETS is being piloted, while oa number of other initiatives are in the process of being developed and/or formalized.

Mexico has a system of tradable emissions permits for CO_2 emissions from direct fixed sources (combustion and industrial processes) in the energy and manufacturing sectors. It has been piloting this ETS since 2020 in two different stages: an actual pilot in 2020 and 2021, and a transitional phase starting in 2022. Mexico's ETS operates as a regulated market; the emissions permits (100,000 tons of CO_2) were assigned free of charge (Semarnat, 2024).

Brazil is working on developing a system of tradable emissions permits. In December 2023, the Chamber of Deputies approved a bill for the regulation of the carbon market that also calls for the creation of what is to be called the Brazilian Greenhouse Gas Emissions Trading System (SBCE). It is hoped that this bill will be passed into law by the Senate in 2024. This would open the way for the creation of a Brazilian ETS as a regulated market, which would make it the largest carbon market in the region. The bill calls for the establishment of an ETS, the use of national emissions offsets up to a certain limit and the regulation of voluntary carbon markets and Article 6 markets in Brazil.

Argentina has had a strategy for creating a framework for the use of carbon markets at the national level in place since 2023. A bill is currently under consideration in Congress that would create an ETS as a regulated market and would authorize the executive branch to determine the number and size of emissions permits and grant those permits to production sectors and activities around the country. Argentina hopes to use this carbon pricing instrument to achieve reductions in emissions that will help it to meet its NDC targets.

Colombia established the National Programme of Tradable Greenhouse Gas Emission Quotas (PNCTE) by Act No. 1931 of 2018. This ETS is currently in the design phase and is scheduled to enter into operation in 2030 as a regulated market. According to the Colombian authorities, PNCTE will make it possible to use the resulting emissions reductions for various purposes, such as, for example, as carbon tax offsets, in international trading under article 6 of the Paris Agreement, use in the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) and participation in voluntary carbon markets (Ministry of Environment and Sustainable Development of Colombia, 2024).

2. The European Union emissions trading system and Carbon Border Adjustment Mechanism

The European Union set up its ETS in 2005 as a way of reducing its GHG emissions. Most of the permits used in its ETS are auctioned off, but some are distributed free of charge, mainly to industries that are at risk of carbon leakage (relocation of companies to areas where the price of carbon is lower), and others are bought and sold in inter-company transactions.

The European Union's ETS has proven to be an efficient means of lowering emissions within that region. In July 2021, the European Commission unveiled a policy package dubbed "Goal 55" aimed at making a 55% reduction in net GHG emissions by 2030. That package includes its Carbon Border Adjustment Mechanism (CBAM), which is intended to create an even playing field for producers in the European Union and in countries outside of it by setting carbon prices for a range of imported products (iron and steel, cement, aluminium, fertilizers, electricity and hydrogen) and phasing out the distribution of free emissions permits to European industries (Morgado, 2022). The European Parliament has announced its intention to include plastics and chemicals in the CBAM by 2026 and to cover all sectors included in its ETS by 2030 (Lee, 2023).

The announcement of this new instrument has sparked interest at the international level in its potential impact on the competitiveness of other countries' economies. In the final analysis, the impact will depend on each country's trade relations with the European Union (initially mainly in respect of the sectors in the CBAM), on each country's ability to adapt to the CBAM by, for example, reducing its carbon intensity, and on each country's domestic carbon pricing policies. Using quantitative analyses, Eicke and others (2021) estimate the impacts of CBAM on individual countries by assessing their risk levels in two scenarios: (i) CBAM addressing only emissions-intensive sectors; and (ii) CBAM targeting the whole economy. These authors used a risk index for their analysis that encompasses the export structure of countries, their emissions intensity, emissions reduction targets and institutional capacities to monitor and report product-based emissions. Their findings indicate that the effects of CBAM are distributed unevenly and that countries in Africa could be the most seriously affected. The authors' findings regarding Latin America and the Caribbean indicate that Honduras and Trinidad and Tobago could feel the greatest impact (see table 3).

Table 3
Potential impacts of the European Union CBAM in the Americas

Country	European Union exports *(Percentages of GDP)*	Carbon intensity
Honduras	5.88	16.63
Trinidad and Tobago	4.16	12.58
Guyana	4,05	31.59
Costa Rica	3.62	8.86
Peru	2.95	12.72
Ecuador	2.85	14.58
Chile	2.70	14.43
Nicaragua	2.47	19.15
Brazil	2.09	9.41
Bolivia (Plurinational State of)	1.85	16.58
Suriname	2.88	42.24
Paraguay	1.78	3.66
Mexico	1.57	15.58

Source: S. Weko and others, "The global impacts of an EU Carbon Border Adjustment Mechanism", *IASS Policy Brief*, No. 6/2020, Potsdam, Institute for Advanced Sustainability Studies (IASS), 2020; L. Eicke and others, "Pulling up the carbon ladder? Decarbonization, dependence, and third-country risks from the European carbon border adjustment mechanism", *Energy Research & Social Science*, vol. 80, Amsterdam, Elsevier, 2021.

The analysis of the CBAM conducted by ECLAC concerning the subregion composed of Costa Rica, Cuba, the Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua and Panama indicates that the overall economic impact of the CBAM will be confined to those countries. This is partly because the United States is such a major importer of products from the countries of that subregion and accounts for such a large part of their exports that the European Union's trade relations with the subregion are fairly limited in terms of both their exports in general and those included in the CBAM, in particular. In fact, the products included in the CBAM represent, on average, just 0.09% of the subregion's exports to the European Union, which translates into an average impact on the subregion's GDP of less than 1% (Lee, 2023).

3. Article 6 and carbon markets

Article 6 of the Paris Agreement paves the way for countries to achieve their national emissions reduction targets by cooperating with one another. It was crafted with the aim of encouraging public and private agents to join forces in their GHG mitigation efforts and to help them lower the cost of meeting their NDC mitigation targets through the use of economic incentives. It is also focused on promoting regional and international cooperation in the pursuit of ambitious climate action efforts. Article 6 basically sets out three tools that the countries can choose to use, if they so wish, to meet their NDC targets: (i) Internationally Transferred Mitigation Outcomes (ITMOs), which are based on market mechanisms and are to be traded under bilateral agreements (article 6, para. 2); (ii) a centralized international UNFCCC mechanism for trading carbon credits (article 6, para. 4); and (iii) non-market approaches for promoting international cooperation with the support of the UNFCCC secretariat that do not involve carbon credits but rather support for or means of facilitating implementation, such as technology transfer, capacity-building and financing (article 6, para. 8).

Article 6 therefore opens the way for the creation of national and international carbon markets. Two types of markets could be established: (i) government-regulated compliance carbon markets; and (ii) voluntary carbon markets. In Latin America and the Caribbean, countries are working to take advantage of the opportunities opened up by article 6 of the Paris Agreement to fund and execute emissions reduction projects. A number of countries have been piloting article 6 projects. Some examples of those pilots are given in table 4.

Table 4
Article 6 pilot projects involving countries of Latin America and the Caribbean

Purchasing country	Host country
Switzerland	Chile, Dominica, Peru, Uruguay
Japan	Costa Rica, Mexico, Chile.
Singapore	Colombia, Peru, Chile, Costa Rica, Dominican Republic, Paraguay
Sweden	Dominican Republic

Source: Prepared by the authors, on the basis of B. Granziera, K. Hamrick and J. Verdieck, *Article 6 Explainer. Questions and Answers about the COP27 Decisions on Carbon Markets and What They Mean for NDCS, Nature, and the Voluntary Carbon Markets*, Arlington, The Nature Conservancy, 2023.

C. The effectiveness of carbon pricing

The impacts of carbon pricing and other mitigation policies on fuel use and the associated emissions depend on a number of factors, including: (i) their proportional effect on future energy prices; (ii) changes in fuel use in the energy generation sector; and (iii) the price elasticities of electricity and fuel use in other sectors (Parry, Black and Roaf, 2021). Because carbon pricing systems are not widespread in Latin America and the Caribbean and because of the low level of carbon prices in the systems that do exist in the region, there is very little evidence on which to base a judgment as to their effectiveness in reducing GHG emissions or generating revenues for use in facilitating a fair climate transition.

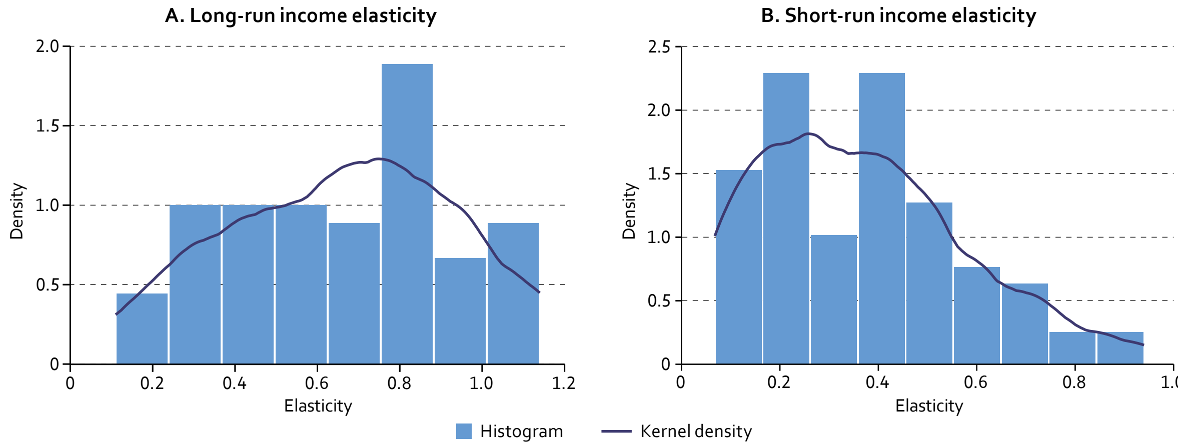
1. The demand elasticities of fuels

The reasons cited for implementing the carbon pricing systems that are in operation thus far in Latin America and the Caribbean are that they will help the countries to fulfil their climate commitments under the Paris Agreement and their NDCs and that they will boost tax revenues. While differing from country to country, most of the carbon taxes being used in the region are levied on the carbon content of fossil fuels; Chile is an exception in that its tax applies to fixed-source carbon emissions.

Under these circumstances, the effectiveness of carbon taxes in reducing emissions will in part be determined by how economic agents respond in terms of their fuel use to changes in price or income, which is measured by the price and income elasticities of the demand for fuels. Determining these price and income elasticities is therefore of key importance in measuring the potential reduction in fuel consumption and, hence, in CO_2 emissions and the estimated revenues from carbon taxes. Both around the world and in the Latin American and Caribbean region, there is a great deal of literature on fuel demand elasticities that can be used to help gauge these levels. The available evidence, synthesized in a meta-analysis,[8] shows that the income elasticity of fuel demand follows the income curve (see figure 21), whereas its price elasticity is lower (see figure 22).

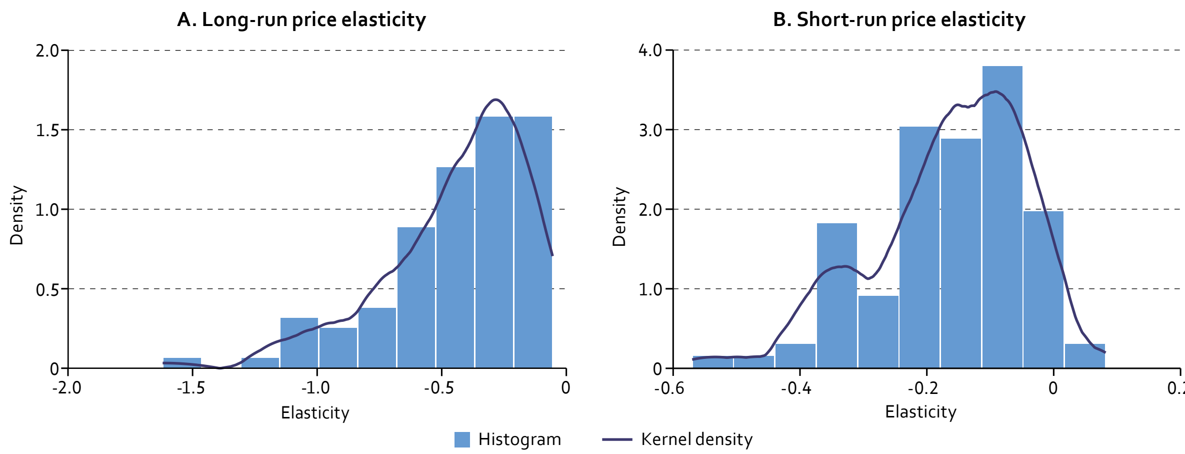
[8] A meta-analysis involves a statistical synthesis of data from which more accurate inferences can be drawn than from separate studies. Such analyses also provide a way of exploring the differences in the findings of individual studies (Borenstein and others, 2009). The meta-analyses discussed here are based on 151 estimates of the income elasticity of fuel and 208 estimates of price elasticities.

Figure 21
Distribution of the income elasticity of fuel demand



Source: Prepared by the authors, on the basis of international statistical data.
Note: The histograms plot the distribution of 151 estimates of the income elasticity of fuel demand at the international level.

Figure 22
Distribution of the price elasticity of fuel demand



Source: Prepared by the authors, on the basis of international statistical data.
Note: The histograms plot the distribution of 208 estimates of the price elasticity of fuel demand at the international level.

The analysis of the estimates at international level show that fuels are price-inelastic in the short run, which means that changes in the demand for fuel are proportionally smaller than changes in its price. This is partly because economic agents cannot adjust their levels of consumption in the short run if they cannot find any substitutes relatively quickly. However, the results also indicate that the price elasticity of fuel demand is greater in the long run.

A review of the results of the meta-analysis of the demand elasticities of fuel by regions or groups of countries shows that income elasticity is lower in the OECD countries than in those of Latin America and the Caribbean but that the price elasticity is higher in the former than in the latter (see table 5). Consequently, a similar pace of economic growth in the OECD and in Latin American and Caribbean countries will lead to differing rates of growth in the demand for fuel. In other words, a more intensive decoupling of economic growth from fuel consumption can be found in the OECD countries than in Latin America and the Caribbean. The results also point to the low price elasticity of fuel consumption, which has to do with the more limited availability of substitutes. In Latin America and the Caribbean, this low elasticity also reflects the absence of efficient, quality public transportation systems that could be seen as a substitute for private means of transportation. In countries where the government provides fuel subsidies, the results show that demand is inelastic both in the short and long terms, which entails obvious externalities and fiscal costs. This once again brings the debate surrounding the reduction and elimination of fossil fuel subsidies to the fore.

Table 5
Income and price elasticity of fuel demand, by region or group of countries

Region or group of countries	Income elasticity		Price elasticity	
	Long run	Short run	Long run	Short run
Latin America and the Caribbean	0.73	0.36	-0.34	-0.12
OECD	0.60	0.31	-0.45	-0.18
Economies with fuel subsidies	0.57	0.28	-0.21	-0.07

Source: Prepared by the authors, on the basis of econometric estimate results from the meta-analysis.
Note: Elasticity weighted by the standard deviation was estimated using the random-effects model. In all cases, the *Q* test rejects the null hypothesis that the estimates are homogeneous. The *I2* statistic indicates that the proportion of the variation in the magnitude of the effects that can be attributed to heterogeneity between studies is greater than 85% for both the long-run and the short-run income and price elasticities. The entries for OECD refer to all the member countries of that organization except Chile, Mexico and Colombia. The entries for "Economies with fuel subsidies" refer to oil-producing countries and/or countries that provide fossil fuel subsidies amounting to more than 10% of their GDP.

Differences in the price and income elasticities of fuel demand also point up the following public policy considerations. One is that public policies based on pricing mechanisms will not be enough in themselves to lower fuel consumption and CO_2 emissions because the increase in demand associated with an increase in income (the income effect) will outweigh the reduction obtained by increasing its price (the price effect). Another consideration is that complementary measures will be needed in order to succeed in achieving a significant reduction in the emissions produced by fuel use. The development of efficient public transportation systems, including those powered by electricity, along with more efficient fuels and technological progress in the motor vehicle industry, could not only help to mitigate emissions but could also bring other benefits in such areas as health (lower morbidity and mortality), productivity (shorter commute times) and fewer road accidents.

In analysing the effectiveness of carbon pricing, consideration also needs to be given to related policy tools, such as fossil fuel subsidies. Petrol subsidies are common in many countries of the region, but they are an incentive that jeopardizes the region's climate objectives, since they cheapen and thus stimulate fossil fuel consumption (thus boosting emissions) and delay investment in alternatives to fossil fuels. Carbon taxes are an incentive for redirecting energy investments towards low-carbon technologies such as power plants that are fuelled by renewable forms of energy (Parry, 2019). In the countries of Latin America and the Caribbean, fossil fuel subsidies greatly outstrip investment in renewable energy, which is yet another reason for revisiting subsidization policies.

The Latin American and Caribbean countries generally have a very limited amount of fiscal space, and carbon pricing systems would enable them to expand that space and strengthen their weakened public finances. The systems in operation in the region are quite fragile, however, partly because the carbon prices they have set are so low. Even so, carbon tax revenues could help to finance the investments needed to achieve the Sustainable Development Goals, especially Goal 13 on climate action. In all the countries, the use of a portion of these revenues to finance clean energy infrastructure could help to gain acceptance for the use of carbon prices (Parry, 2019). Given the negative reaction of much of the population to rising fuel prices, however, thought should be given to using another part of those tax revenues to provide direct support to the more disadvantaged sectors of society. This topic will be addressed in more detail in the following section.

The above observations suggest that the region has the manoeuvring room it needs to lower and eventually phase out its fossil fuel subsidies, which would also lighten the financial burden borne by the

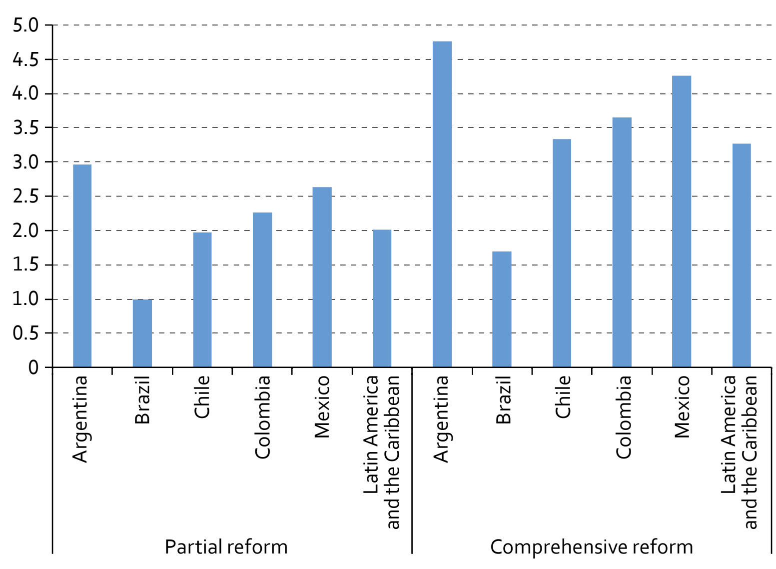
State in this respect. There are also technical reasons for raising carbon prices, since this would not only put public finances on a sounder footing but would also help provide domestic financing for climate action and the fulfilment of each country's NDC commitments.

2. Reforming subsidies

Although reforming fossil fuel subsidy policies would not be a very popular move, it may be a necessary one from the standpoint of economic efficiency in order to do away with the distortions and externalities that those subsidies cause. The simulation of macroeconomic models for the reform of fossil fuel subsidies carried out by Black and others (2023) shows that the net results are positive ones for the countries of Latin America and the Caribbean. Those authors ran a partial reform scenario and a comprehensive reform scenario. The latter assumes that all the countries in Latin America and the Caribbean gradually raise their fossil fuel prices until reaching efficient price levels by 2030, while the former assumes an increase in fuel prices that will close half of the gap between pre-reform price levels and efficient price levels.[9] The measurements of the effects of these policy changes covered adjustments in the prices of different grades of petrol and the prices of natural gas, petroleum, coal and electricity and their residential use, industrial use and use in power generation. The impacts on income and GHG emissions and their corollary environmental benefits in terms of air quality and health impacts were all evaluated. The net welfare impact was also measured by gauging the environmental benefits (climate change, emissions, accidents, productivity and others) minus the economic costs of changes in welfare.

Figure 23 depicts the effect of the reform of subsidization policies on revenues under each of the two scenarios in both the Latin American and Caribbean region as a whole and in selected countries. The results of the simulations indicate that a partial reform would boost revenues by US$ 142 billion (2.0% of the region's GDP) by 2030 relative to the baseline, taking into account the loss of revenues occasioned by the erosion of the pre-existing fuel tax base and the savings of public budgetary funds realized by reducing the subsidies. The simulations also show that a comprehensive reform would increase the revenues of the region as a whole by US$ 231 billion (3.3% of the region's GDP) by 2030 relative to the baseline.

Figure 23
Change in income generated by a reform of fossil fuel subsidization policies in selected Latin American countries and in the Latin American and Caribbean region as a whole
(Percentages of GDP)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023.

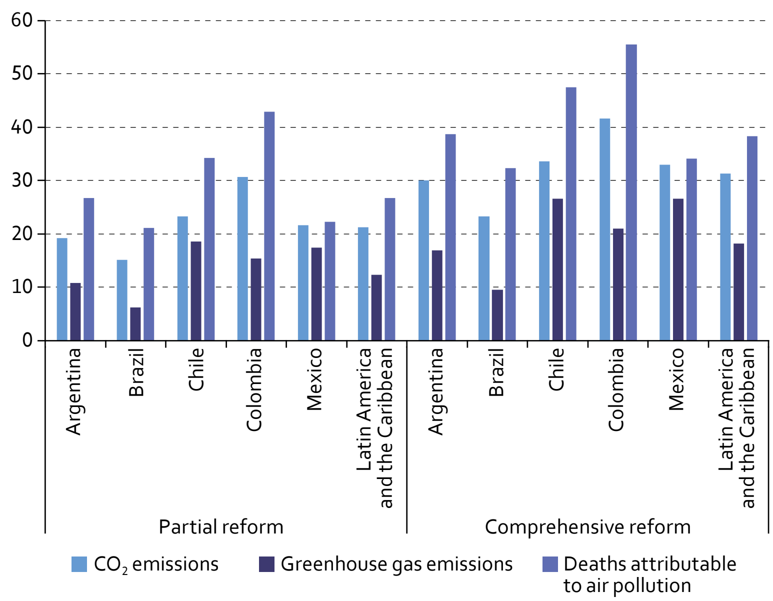
[9] A more detailed discussion of the methodological aspects of this exercise is provided in the annexes and in Black and others (2023).

Subsidy reforms not only have an impact on fiscal revenues but also can modify fuel consumption trends and thus have an impact on GHG and local pollutant emissions. A partial reform of these subsidies in Latin America and the Caribbean is estimated to reduce regional CO_2 emissions from fossil fuels by 21% relative to the baseline by 2030, while the reduction of CO_2 emissions would amount to an estimated 31% under a full reform (see figure 24). The size of the reductions in CO_2 emissions under these reforms would vary across countries depending on the composition of their energy matrix. In addition the partial and full subsidy reforms would help to reduce GHG emissions (excluding CO_2 emissions attributable to land use, changes in land use and forestry) by 12% and 18%, respectively relative to the baseline by 2030. These reductions would make a significant contribution to the effort to achieve the region's climate goals as reflected in its NDC 2030 targets.

The burning of fossil fuels that would be averted by such subsidy reforms would also improve air quality in the region's major urban centres, which would also have a beneficial effect on public health. A partial reform would reduce deaths attributable to air pollution by an estimated 27% relative to the baseline by 2030, while a comprehensive reform would result in an estimated reduction of 31% in such deaths.

The evaluation of the projected effects of fossil fuel price reforms in the region points to net benefits in terms of well-being. The partial reform scenario for Latin America and the Caribbean yields economic costs equal to 0.4% of the region's GDP and environmental benefits equal to 2.4% of its GDP; the net benefit in welfare therefore equals 2.0% of the region's GDP, which is equivalent to US$ 141 billion (see figure 25). The corresponding results for the full subsidy reform scenario are: environmental benefits amounting to 3.9% of GDP, economic efficiency costs of 1.2% of GDP and net economic benefits totalling 2.7% of regional GDP. The economic cost of the subsidy reform is represented by the value of the benefits forgone by fossil fuel consumers less the fiscal savings in supply costs. These figures need to be viewed with caution, however, since the size and sign of the effects will depend on the use made of the fiscal income generated by the reforms (Black and others, 2023).

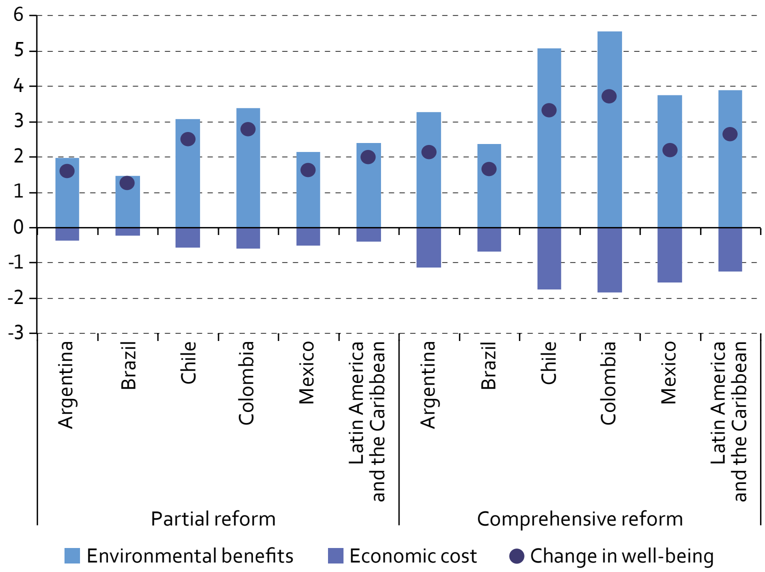
Figure 24
Impact of subsidy reforms on CO_2 emissions and on deaths attributable to air pollution
(Percentages of change relative to the baseline)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023.
Note: GHG emissions do not include CO_2 emissions from land use, changes in land use or forestry.

The results of the reform of subsidization policies would vary across the countries of the region, since they would depend on the size of the subsidies and the make-up of each country's energy matrix. Among the countries shown in the preceding figures, for example, the largest changes in incomes under a full reform would be seen in Argentina and Mexico (4.8% and 4.3% of GDP, respectively); Colombia, Chile and Mexico would have the biggest reductions in CO_2 emissions; and Colombia, Chile and Argentina would register the sharpest drop in deaths attributable to air pollution; the greatest net benefits in terms of changes in welfare would be realized by Colombia and Chile (3.7 and 3.3% of GDP, respectively).

Figure 25
Impact of fossil fuel subsidy reform on economic welfare
(Percentages of GDP)



Source: Prepared by the authors, on the basis of S. Black and others, "IMF fossil fuel subsidies data: 2023 update", *IMF Working Papers*, No. 2023/169, Washington, D.C., International Monetary Fund (IMF), 2023.

D. The social price of carbon and public investment in the countries of Latin America and the Caribbean

Another form of carbon pricing is to set the price implicitly by assigning a monetary value to emissions, just like any other externality, in the financial sector's investment evaluation process or in the public sector's methodologies for evaluating investment projects. Standards or regulations can thus also be used to establish an implicit price in the form of shadow or social prices that will act as an incentive for low-emissions investments. This type of carbon pricing does not reduce existing GHG emissions but it will help to prevent them from increasing and is an ex ante price for carbon that does not have a social impact.

According to the report of the High-Level Commission on Carbon Prices, governments can increase the effectiveness of carbon pricing by building technical and institutional capacity and configuring regulatory frameworks that are aligned with the Paris Agreement objectives. Explicit carbon pricing can be usefully complemented by shadow pricing (the social price of carbon) in public sector activities (Stern and Stiglitz, 2017). The reasoning behind the use of the social price of carbon is that it will introduce a price signal that will correct the inefficiencies generated by the negative externality associated with anthropogenic GHG emissions. In other words, the purpose of using the social price of carbon is to internalize its social costs in the decisions made by the economic agents (investors, producers and consumers) that are responsible for the emissions. This means that the optimum social price of carbon is the price at which the marginal cost of reducing emissions (mitigation) is equal to the marginal cost of the damage caused by climate change (the marginal benefit of removing pollution) (Rabl, Spadaro and Holland, 2014).

Thus, it is important for the countries to define a social price for carbon because this will allow them to create enabling frameworks for steering investment decisions towards low-carbon activities and sectors and decoupling emissions from economic development. Incorporating the social price of carbon into the public investment evaluation process will help to alter the relative profitability of different investment options in ways that will promote low-emissions projects. This will, in turn, help to ensure that public budgets are used in a more cost-efficient way that is aligned with the countries' climate action commitments. By the same token, having established the social price of carbon will facilitate access to financing from the multilateral banking system, some of which may come in the form of soft loans, for low-emissions projects.

There are various methodologies for estimating the social price of carbon. Some of the most common approaches focus on: (i) the social cost of carbon; (ii) the mitigation cost entailed in achieving a given public policy objective; and (iii) defining the price based on international evidence. An overview of each of these methodologies follows.

The social cost of carbon

The social cost of carbon is a methodological approximation based on the calculation of the marginal damage caused by climate change. This is an estimate of the economic (and social) cost of each additional ton of CO_2 equivalent (CO_2eq) emitted into the atmosphere (Nordhaus, 2014; Kikstra and others, 2021); in more specific terms, it represents the change in the discounted value of economic welfare for each additional unit of CO_2eq emissions (Tol, 2019; Nordhaus, 2014). Estimation of the social cost of carbon is complicated because it involves considering such a wide range of impacts from CO_2eq emissions encompassing the entire carbon life cycle and the economic damage caused by climate change (Nordhaus, 2018). It takes into account both the negative and the positive impacts of CO_2eq emissions and climate change and is therefore a net value that is expressed in terms of the monetary value of future damage from the emission of one ton of CO_2 into the atmosphere or the benefits of a one-ton reduction in CO_2 emissions in a given year (Pica and others, 2024a). The social cost of carbon is a measurement of the magnitude of the externality that should be incorporated into governments' decisions about policy and investment options (Price, Thornton and Nelson, 2007). The estimation of the social cost of carbon is therefore derived by modelling the marginal damage curve, which can be done using a process involving four working modules covering the paths of different variables (see table 6).

Table 6
Working modules and variables considered in the estimation of the social cost of carbon

1	Socioeconomic module	• Global CO_2 emissions • Population • Per capita GDP growth
2	Climate module	• CO_2 concentrations • Changes in temperature and precipitation • Rising sea levels
3	Impact module	• Agriculture, energy • Damage to coastal zones • Health, mortality
4	Discount module	• Social discount rate • Discounted marginal damage

Source: Prepared by the authors.

Calculating the social cost of carbon is a recursive process because each stage provides feedback for the others. For example, given impacts may have an effect on the socioeconomic scenarios and on CO_2eq emissions, resulting in greater or lesser concentrations in the atmosphere. This evaluation is based on integrated assessment models (IAMs), which use economic approaches to climate change that incorporate different elements in a single interrelated model (Nordhaus, 2018). Some of the best-known IAMs are the Dynamic Integrated Climate-Economy (DICE), Framework for Uncertainty, Negotiation and Distribution (FUND) and Policy Analysis of Greenhouse Effect (PAGE) models.[10] The main criticisms of IAM have to do with the underestimation of the damage because of a failure to include all possible forms of market-based and non-market damage, weaknesses in the quantification of extreme events and their impacts, and the fact that future generations' benefits and well-being are evaluated in relation to the sacrifices made by today's generations (Pica and others, 2024a).

The mitigation cost entailed in achieving a given public policy objective

An alternative methodology for defining the social price of carbon is to estimate it based on the cost of the extent of mitigation required to achieve a given public policy objective. This method is based on marginal abatement cost curves (MACCs) and the definition of a carbon budget associated with the public policy objective. The advantage of this method is that it requires less data than the IAMs do, since it can be applied using only such types of country information as emissions models and the costs of the measures considered necessary to achieve the policy objective in question. The emissions reduction targets set by the countries in their NDCs that are to be reached within a defined time horizon are a good example of the kind of public policy objective dealt with in this methodology. The mitigation objective then serves as a basis for determining the country's carbon budget. In order to construct the MACC, emissions scenarios and projections are needed for the sectors prioritized in the NDC and for the various policy options for achieving the objective. This methodology also has the advantage of generating a price signal that is consistent with national mitigation objectives and of encouraging climate action focusing on all the public investment initiatives evaluated on the basis of the social price of carbon.

The MACC ranks mitigation measures in order, from the most economic to the costliest ones, thus tracing a path for how to go from a business-as-usual baseline to the maximum degree of mitigation as economically as possible. By overlaying the carbon budget on the marginal abatement cost curve, the social price of carbon needed to achieve the public policy objective can be determined. This approach does, however, carry the risk of arriving at potentially negative values for the social price of carbon if the mitigation objective defined by the country is not sufficiently ambitious.

The estimate based on the mitigation cost of achieving a public policy objective may not necessarily reflect the socially optimum price of carbon, but it will indicate the social price of carbon necessary for achieving the defined mitigation target. If this price signal is received by all sectors of the economy, it will promote the implementation of cost-efficient measures and thus the achievement of the mitigation objective at the lowest possible cost for the economy.

The biggest challenges associated with this methodology have to do with the required mitigation studies, the use of cost assumptions, the modelling of policy measures and the decision about the discount rate to use. The models can be used to estimate the reduction in CO_2e emissions that will be produced by each measure *i* in line with the carbon budget, and the marginal abatement cost of each measure *i* is obtained from the following equation:

$$Marginal\ abatement\ cost = \frac{Present\ value\ of\ incremental\ costs}{Reduction\ of\ greenhouse\ gas\ emissions_i} \quad (2)$$

[10] The characteristics of these three models are summarized in ECLAC (2024) and Pica and others (2024a).

An evidence-based policy definition

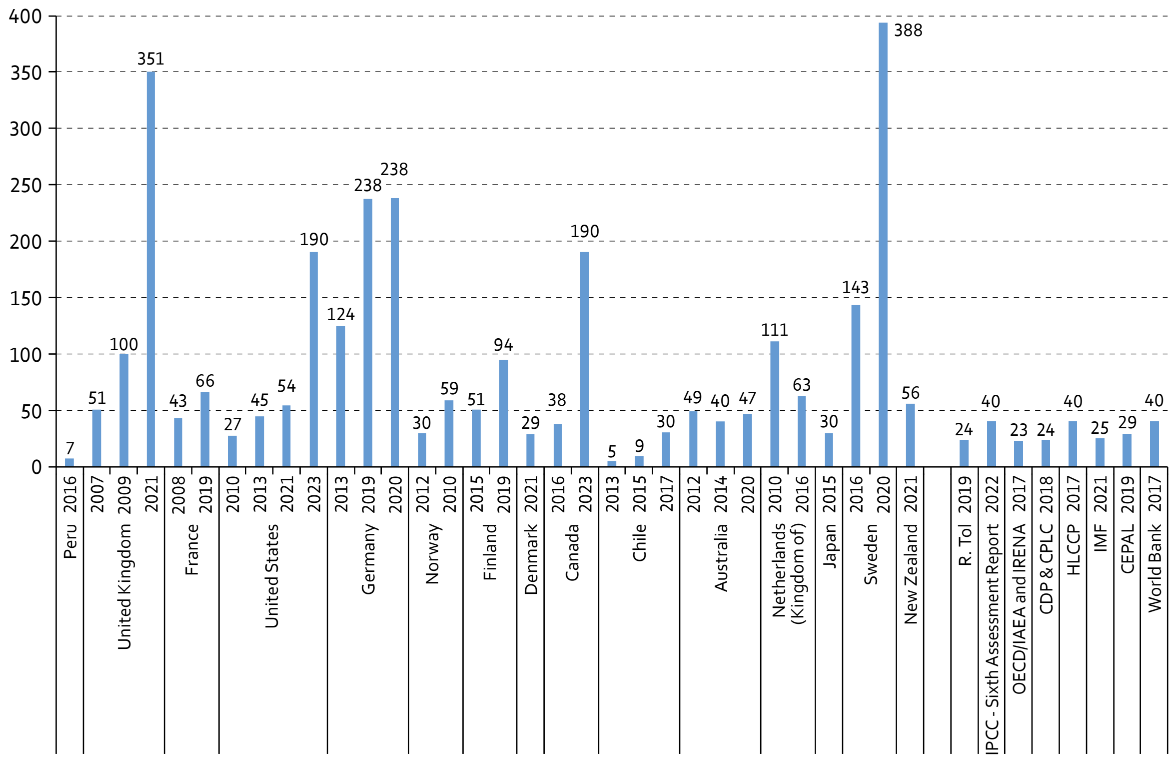
As mentioned above, the methodologies for arriving at the social cost of carbon and for determining the mitigation costs entailed in achieving a given policy objective require a large amount of information and high-level technical capabilities for their application, which can be costly in economic terms and time-consuming. A third option is to define the social price of carbon at the national level by means of an evidence-based policy decision. The main source of such evidence is the estimates of the social price of carbon arrived at by various countries both in the Latin American and Caribbean region and elsewhere. Alternatively, estimates of the social price of carbon reported in the specialized scientific literature can be used as a reference. Yet another possible source of such evidence is the recommendations made by international organizations that have researched the subject. Carbon market prices are also often used as a point of reference for defining this shadow price.

This evidence-based approach for determining the social price of carbon has been used by a number of countries. In 2016, Canada defined its social price of carbon based on the value calculated for the United States by the Interagency Working Group (IWG, 2016). In 2021, Denmark and, in 2013 and 2015, Chile defined their social prices of carbon based on carbon market prices. A social price of carbon can also be based on the recommendations of international organizations concerning carbon pricing (whether for social prices or for carbon taxes). In 2019, ECLAC undertook a meta-analysis in order to determine a reference value for the social cost of carbon for public policy purposes and obtained a potential value of US$ 25.83 /tCO_2eq (Alatorre and others, 2019). In 2021, IMF conducted a study in which it recommended three levels of carbon taxes (US$ 25, US$ 50 and US$ 75 /tCO_{2eq}) for countries of differing income levels (Parry, Black and Roaf, 2021). In 2017, the World Bank drew up a guidance note for private sector projects seeking financing from the Bank concerning the use of shadow carbon prices in economic analyses. In that note, it recommends using the values provided by the High-Level Commission on Carbon Prices for 2020–2030 and extrapolating them for 2030–2050 using an annual growth rate of 2.25% (Stern and Stiglitz, 2017).

Figure 26 provides a summary of the social prices of carbon that have been used by different countries and some of the values that have been recommended in the literature by international bodies or specialized agencies concerned with climate change and carbon prices. A valid technical way of sifting through the extensive international evidence on the subject in order to define a social price for carbon at the national level is the multi-criteria analysis (MCA) approach, which can evaluate the performance of each option (estimate) as a social price of carbon in the relevant country using the same metrics in each case.

Under the EUROCLIMA programme, since 2019 ECLAC has been implementing the Social Price of Carbon in the Evaluation of Public Investment Projects in Latin America initiative in support of the national public investment systems belonging to the Network of National Public Investment Systems in Latin American and the Caribbean (RedSNIP). This regional initiative is working on the inclusion of climate change considerations in public investment evaluations, improvements in the efficiency of expenditure and ensuring that budget allocations are consonant with the Paris Agreement objectives. As part of this regional effort, it has provided technical assistance for the updating of social prices of carbon in Chile and Peru and for first-time estimates of those prices for Costa Rica, the Dominican Republic, Honduras, Nicaragua, Panama and Paraguay.

Figure 26
National estimates of the social price of carbon and values suggested by international organizations
(Dollars at 2021 prices per ton of CO_2 equivalent)



Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), Social Price of Carbon in the Evaluation of Public Investment Projects in Latin America initiative.

1. The social price of carbon in Chile

As part of its policy package for addressing climate change, in addition to a carbon tax, Chile also uses a social price for carbon in its procedures for evaluating possible public investment projects. It introduced that price in 2013 when the Social Investment Evaluation Division of the Ministry of Social Development conducted an exercise to estimate the social price of carbon so that it could use that price in its social project evaluation process to help it gauge the cost (or benefit) of the increase (or decrease) in GHG emissions associated with a given investment project (Poch Ambiental, 2016). Chile has been a leader in Latin America and the Caribbean in using this shadow price in public investment evaluations. Since the government's introduction of the social price in 2013, it has been updated three times using different methodologies (see table 7).

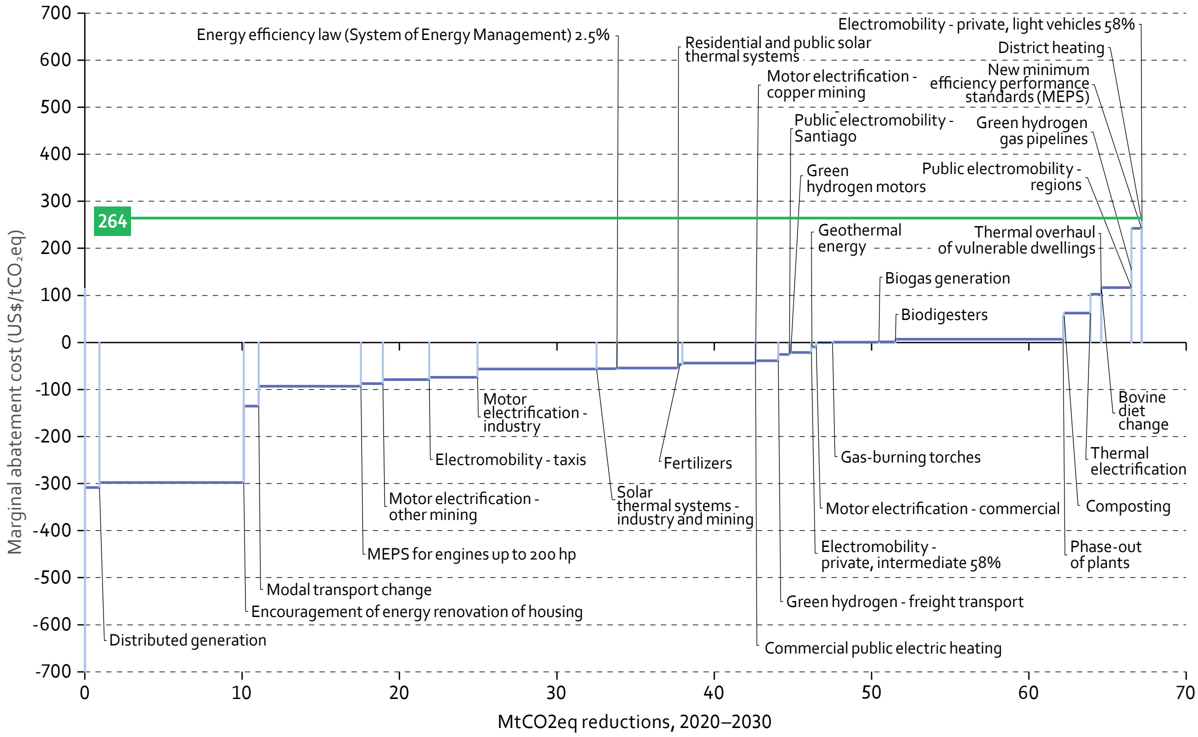
Table 7
Social price of carbon estimates in Chile
(Dollars per ton of CO_2 equivalent)

Year	Social price of carbon	Estimation method
2013	4.05	Market price of carbon
2015	8.44	Market price of carbon
2017	32.50	Marginal abatement costs

Source: Prepared by the authors, on the basis of Ministry of Social Development of Chile, *Estimación del precio social del CO_2*, Santiago, 2017.

In late 2021, the Ministry of Social Development and the Family set up a panel tasked with updating the social price of carbon using the country's NDC, updated to 2020, as a basis. The panel also includes representatives of the Ministry of Energy, Ministry of the Environment and Ministry of Finance. This panel is working to reach a consensus estimate of this shadow price with a view to promoting its application in social evaluations of public investment projects (Ministry of Finance of Chile, 2022). Since 2019, ECLAC has been providing technical support to this panel, which has now issued an updated social price of carbon for 2024. The new estimate was calculated using the methodology focusing on the mitigation cost of achieving a public policy objective. The policy objectives employed in the calculations were based on the country's updated NDC emissions reduction commitments for 2030 and the carbon neutrality objectives figuring in its long-term strategy up to 2050. The information associated with these climate action objectives was used to construct the carbon budget. Thanks to the coordinated efforts of the ministries represented on the panel, the mitigation measures and the marginal abatement costs were then used to plot the MACC (see figure 27).

Figure 27
Chile: marginal abatement cost curve (MACC) for 2020–2030
(Dollars per ton of CO_2 equivalent)



Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Chile", *Project Documents* (LC/TS.2024/110), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.

The measures are listed in order, from the lowest marginal abatement cost to the highest, which facilitates the construction of the MACCs and the definition of the social price of carbon. That price corresponds to the last mitigation measure on the list, at which point the achievement of the NDC reductions is considered to be ensured. The results of this exercise indicate that the social price of carbon needed to achieve carbon neutrality by 2050, based on the NDC calculations, corresponds to the marginal abatement cost of the last mitigation measure on the list. Accordingly, the social price of carbon is US$ 264.15/tCO_{2eq}. However, this value is eight times greater than the current price, so the decision was to scale up the price from US$ 32.5/tCO_2eq in2020 (the starting year for evaluation and the year of publication of Chile's NDC) to US$ 264.15/tCO_2eq in 2050 (the year targeted for achieving carbon neutrality) (see table 8).

Table 8
Chile: stepped increase in the social price of carbon, 2020–2050
(Dollars per ton of CO_2 equivalent)

Year	Social price of carbon
2020	32.5
2024	63.4
2025	71.1
2030	109.7
2040	186.9
2050	264.2

Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Chile", *Project Documents* (LC/TS.2024/110), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.
Note: The increase in the social price of carbon follows a linear function of $y = 7.72x + 24.778$ until reaching US$ 264.2.

The estimates for Chile put the social price of carbon at US$ 63.4/tCO_2eq for 2024 (Ministry of Social Development and the Family, 2024) US$ 71.1/tCO_2eq for 2025 and US$ 109.7/tCO_2eq for 2030. While that seems high in comparison to the current price, a number of jurisdictions around the world have also tended to raise their carbon prices in recent years. Uruguay has put its carbon price at US$ 155/tCO_2, and the studies being carried out by the United States in order to raise its price indicate that the increase is likely to be from US$ 51/tCO_2 to US$ 191/tCO_2.

2. The social price of carbon in Peru

Peru was the second country in the region to incorporate the social price of carbon into its public investment evaluation process. In 2016, the Ministry of Economic Affairs and Finance of Peru set its shadow price at US$ 7/tCO_2e based on the social cost of carbon methodology. This was done after the country had presented its preliminary NDC to UNFCCC in 2015. Later, in 2020, the Peruvian government submitted its updated NDC, in which it sets an unconditional mitigation target of limiting emissions to no more than 208.8 MtCO_2eq in 2030 and a conditional target (subject to international support) of 179.0 MtCO_2eq for that same year (Government of Peru, 2020). The projection of the NDC targets for emissions in 2030 provides the basis for constructing the carbon budget for that year.

Peru has differentiated the discount rates it uses in its evaluation of public investment projects. Cost-benefit analyses of public investment projects expected to have social benefits over a 20-year time horizon are conducted using an 8% social discount rate. For the evaluation of longer-term projects, a sliding downward scale is used (see table 9). A higher discount rate generally implies a lower future valuation, and the assumption therefore is that a lower investment is needed at the present time to protect people from future impacts. A lower discount rate, on the other hand, places greater emphasis on future generations and implies that action must be taken in the present.

Table 9
Peru: decreasing social discount rates for longer-term investment projects

Years	Rates *(Percentages)*
0–20	8.0
21–49	5.5
50–74	4.0
75–99	3.0
100–149	2.0
150–199	2.0
200 or more	1.0

Source: Prepared by the authors, on the basis of General Directorate of Multi-Annual Investment Programming (DGPMI) of Peru.

In order to contribute to the fulfilment of the country's new climate action commitments, the General Directorate of Multi-Annual Investment Programming of the Ministry of Economic Affairs and Finance has updated the social price of carbon used in the cost-benefit analyses that form part of the country's public investment project evaluation procedures. The social cost of carbon methodology, which appraises the externalities of climate change, was used for these calculations.

The calculation of the social cost of carbon was carried out using the Mimi Framework platform,[11] which was developed by the Resources for the Future (RFF) team as part of the Social Cost of Carbon Initiative. The new calculations are based on the most updated versions of the most commonly used models: the DICE-2016 R2 (Nordhaus, 2018) and PAGE2020 (Kikstra and others, 2021). While the FUND model has also been used in the past by various centres, it has become somewhat outdated (Waldhoff and others, 2014). Table 10 shows the estimates for the social price of carbon arrived at running the DICE and PAGE platforms with their default values and the results obtained by applying the declining social discount rate for the evaluation of public investment projects used in Peru.

Table 10
Peru: social cost of carbon estimates for 2020
(US$ /tCO_2 at 2021 prices)

Model	Social cost of carbon using the default social discount rate	Social cost of carbon using the declining scale of social discount rates
DICE-2016R2	44	28
PAGE2020	279	32
Average	162	30

Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en el Perú", *Project Documents* (LC/TS.2024/90), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.

There is a clear difference in the default values owing to the differences in the mechanics of the calculations for each model. Each model uses its own discount rates by default, which range from 3% to 5% and therefore yield different valuations of the damage. In addition, the impact evaluations for each model also differ, with the result that the incremental annual damage estimates differ as well. For example, the DICE model uses quadratic functions to estimate the damage caused by rising sea levels, whereas the PAGE model uses exponential functions for this purpose.

Another difference is the inclusion of the "adaptation to climate change" factor, since this implies adjustments to changes in the climate that, for example, would reduce the population's degree of vulnerability in the presence of economic growth. In this case, only PAGE includes this factor, based on econometric studies that indicate how the population, and especially the agricultural sector, will respond to the warming of the planet (Pica and others, 2024d). The Ministry of Economic Affairs and Finance of Peru decided to set the updated social price of carbon at the average of the results (US$ 30/tCO_2 at 2021 prices) of the two models using the declining discount rate, in line with the nationally defined social discount rate, since the two models are equally robust.

3. The social price of carbon in Costa Rica

In its 2020 NDC, Costa Rica commits to holding net emissions down to an absolute maximum of 9.1 MtCO_2eq in 2030 in all sectors covered by the national inventory of GHG emissions (MINAE, 2020). According to its updated NDC, its target is consistent not only with the trend in emissions called for in the National Decarbonization Plan, in which the country also commits to having an economy with net zero emissions by 2050, but also with the path for limiting the rise in global temperatures to 1.5°C. Costa Rica has also committed to having an absolute maximum net emission budget for 2021–2030 of 106.53 MtCO_2eq (MINAE, 2020). In order to work towards the fulfilment of these commitments, since 2023 the National Public Investment System of Costa Rica has included the social price of carbon in its evaluation of public

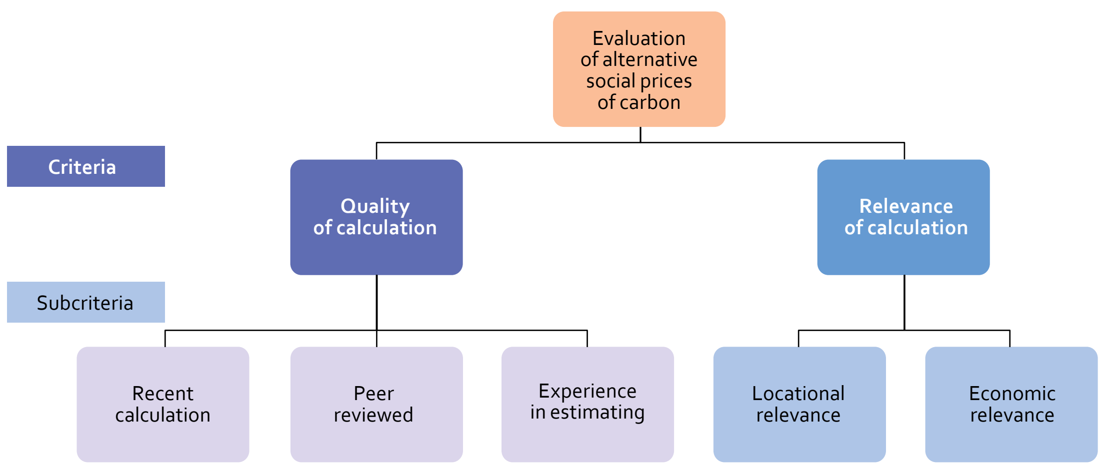
11 See [online] https://www.mimiframework.org/.

investment projects. The Ministry of National Planning and Economic Policy, with support from ECLAC and the EUROCLIMA programme, has incorporated this shadow price into the country's climate policy toolkit to help steer public investment towards low-carbon alternatives.

The Ministry of National Planning and Economic Policy decided to use the evidence-based policy definition methodology for calculating the country's social price of carbon. The calculations were based on a total of 38 estimates of the social price of carbon furnished by national agencies, estimated by international bodies or proposed by specialized groups. The multi-criteria analysis (MCA) method was used to evaluate the alternative prices. A simulation was run of the relative importance for different stakeholders of the various attributes of the social price calculations in order to evaluate the performance of each information source for the various stakeholders. The methodology used for this MCA was the analytic hierarchy process (AHP), which ranks the different alternatives by comparing the relevance of different qualitative and/or quantitative elements.[12]

During the application of this methodology, the available information on the different objectively comparable sources was analysed and, on that basis, a proposal was developed that includes two criteria and five subcriteria. This proposal was then validated at a workshop held with authorities of the National Public Investment System. The hierarchy of these criteria and subcriteria is shown in diagram 2.

Diagram 2
Costa Rica: decision-making framework for the multi-criteria analysis of the social price of carbon

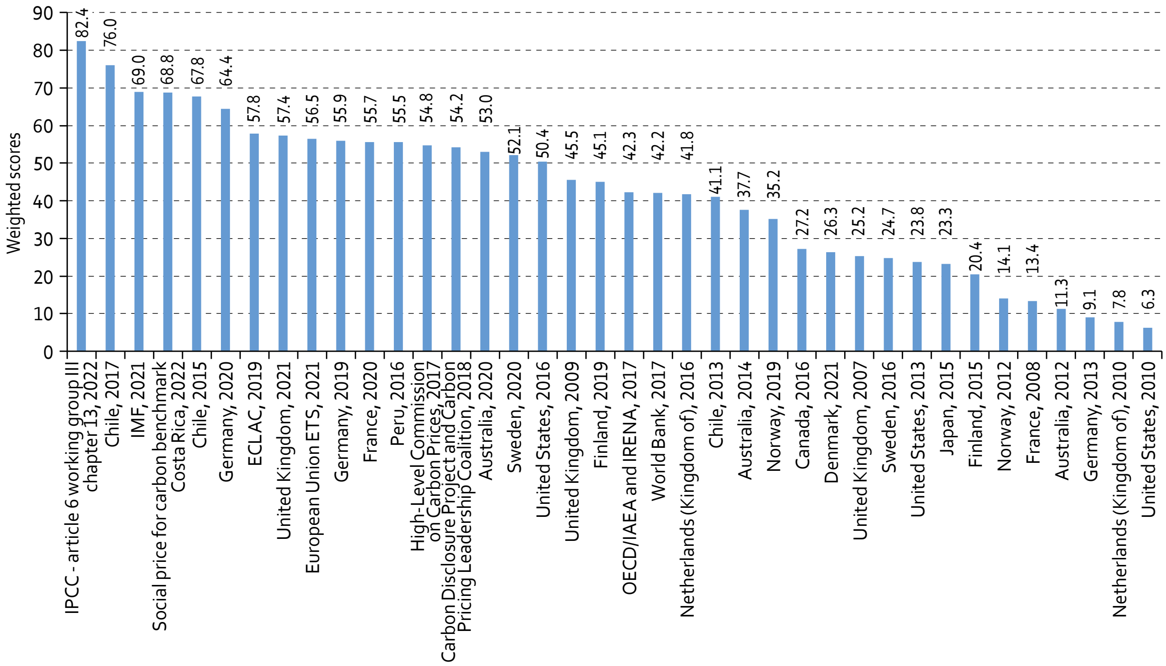


Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Costa Rica", *Project Documents* (LC/TS.2024/21), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.

The application of this method indicates that the best source for the social price of carbon for Costa Rica is the information provided by the Intergovernmental Panel on Climate Change in its *Sixth Assessment Report* (IPCC, 2022). This source had the highest weighted ranking (82.4 points out of 100) (see figure 28). According to IPCC, for the purpose of guiding national and subnational policies, a price signal compatible with the 2021 Paris Agreement objectives should be equal to or greater than US\$ 40/tCO_2eq. Consequently the social price of carbon recommended to Costa Rica within the framework of the technical assistance provided by ECLAC to the Ministry of National Planning and Economic Policy is US\$ 40/tCO_2eq at 2021 prices. That is the value currently being applied in the evaluation of public investment projects.

12 A detailed explanation of the MCA methodology used to estimate the social price of carbon in Costa Rica may be found in Pica and others, (2024b).

Figure 28
Ranking of performance evaluations (0-100 points) of sources of information regarding social prices for carbon



Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Costa Rica", *Project Documents* (LC/TS.2024/21), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.

4. The social price of carbon in the Dominican Republic

The Dominican Republic signed the Paris Agreement in 2015 and ratified it in 2017. In 2020, it submitted the first update of its NDC, in which it included targets for climate change mitigation and adaptation as it works towards building a climate-resilient low-carbon economy. In its updated NDC, the Dominican Republic commits to reducing emissions by 27% relative to a baseline by 2030 by implementing mitigation measures that will require an estimated investment of US$ 8.9 billion and adaptation measures calling for an investment estimated at US$ 8.7 billion.

The National Public Investment System of the Dominican Republic is headed up by the General Directorate of Public Investment of the Ministry of Economy, Planning and Development. In an effort to ensure that public investments will contribute to the fulfilment of the country's climate action commitments, the Public Investment System decided to estimate a social price for carbon and use it in its evaluation of investment projects. The social cost of carbon methodology was used to estimate the shadow price using the integrated DICE–2016 R2 (Nordhaus, 2018) and PAGE2020 evaluation models (Kikstra and others, 2021), those models default values and a declining social discount rate. As in the case of Peru, the discount rate started at 8% for the 2020s and will then decrease at a rate of 10% per decade until reaching 1% in 200 years' time. As noted earlier, calculations using this methodology yield an estimated value for the net marginal damage caused by GHG emissions.

The net present value of the damage is obtained from the marginal values of the damage for each time period in each model and the application of the decreasing discount rate for each period.

$$NPV = \sum_{t} \frac{MD_t}{\prod_{2021}^{t}(1 + SDR_t)} \qquad (3)$$

Where:

NPV = Net present value of the damage (US\$/tCO_{2eq})

MD_t = Marginal damage in period t (US\$/tCO_{2eq})

SDR_t = Marginal social discount rate for period t (%)

t = Year used in the model from 2020 to 2300.

Table 11 shows the results of the estimates for the social cost of carbon obtained by running the DICE and PAGE models using their default values and a decreasing discount rate.

Table 11
Dominican Republic: values for the social cost of carbon, 2020
(Dollars per ton of CO_2 at 2021 prices)

Model	Social cost of carbon using the default social discount rate	Social cost of carbon using the declining social discount rate
DICE-2016R2	44	28
PAGE2020	279	24
Average	162	26

Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en la República Dominicana", *Project Documents* (LC/TS.2023/193), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.

Preliminary estimates were also calculated of the projected values for the Dominican Republic for 2025 and 2030 of the social price of carbon based on the DICE and PAGE models using the declining social discount rate. The results are shown in table 12.

Table 12
Dominican Republic: preliminary estimates of the future social price of carbon
(Dollars at 2021 prices per ton of CO_2)

Model	Social price of carbon for 2025 using the declining social discount rate	Social price of carbon for 2030 using the declining social discount rate
DICE-2016R2	32	37
PAGE2020	34	38
Average	32	38

Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en la República Dominicana", *Project Documents* (LC/TS.2023/193), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024.

By including a social price of carbon of US\$ 26 at 2021 prices per ton of carbon as an additional criterion in its evaluation of public investment projects, the Dominican Republic is seeking to internalize the social cost associated with carbon emissions in its investment decisions with a view to reducing the social profitability of high-carbon investments and increasing the options for low-emissions investments.

5. The social price of carbon in Nicaragua

The General Directorate of Public Investment of the Ministry of Finance and Public Credit of Nicaragua is the body responsible for overseeing the National Public Investment System. Up to 2022, Nicaragua did not use a social price of carbon in its social evaluations of public investment projects. In 2023, with support from ECLAC and the EUROCLIMA programme, Nicaragua used the social cost of carbon methodology to estimate that price based on the most commonly used IAM models (DICE and PAGE), the 8% national social discount rate and the default values of each model.

The calculations were carried out, in line with national mitigation objectives, for 2020, which is the most recent year for which data can be obtained for both models. It is worth clarifying that the values are computed only for that year —in other words, the estimates are of the present and future social damage caused by an additional ton of emissions in 2020— but the model runs for the entire period covered by the calculations. Table 13 shows the values for the social cost of carbon using the two models' default discount rate and the 8% discount rate used in evaluations of public investments in Nicaragua.

Table 13
Values for the social cost of carbon for Nicaragua for 2020
(Dollars at 2021 prices per ton of CO_2)

Model	Social cost of carbon using the default social discount rate	Social cost of carbon using the 8% social discount rate of Nicaragua
DICE-2016R2	44	4
PAGE2020	279	11
Average	162	8

Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Nicaragua", *Project Documents*, Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024, in press.

Using the 8% national social discount rate has a significant effect on the values for the social cost of carbon yielded by the calculations since, given how long greenhouse gases persist in the atmosphere, the externalities associated with climate change primarily manifest themselves over the long term. Consequently, the use of a higher discount rate will necessarily result in the calculations showing a lower social cost of carbon. Nonetheless, using the shadow price of US$ 8/tCO_2 at 2021 prices will still allow Nicaragua to modernize its public investment management tools and help it to fulfil its climate action commitments. The country's updated 2020 NDC establishes a conditional target for the energy sector that increases the share of renewable energy to 65% relative to the base year (2007). In the forestry sector, Nicaragua has made an unconditional commitment to increase its level of ambition to a 25% reduction in emissions. In addition, it has included a target for industrial processes and product use involving a reduction in the consumption of fluoridated gases. Meeting these commitments will require private and public investments in which the use of the social price of carbon will not only show low-carbon investments to be more profitable than their conventional alternatives but will also help investors to secure financing from the development and multilateral banking systems.

6. The social price of carbon in Honduras

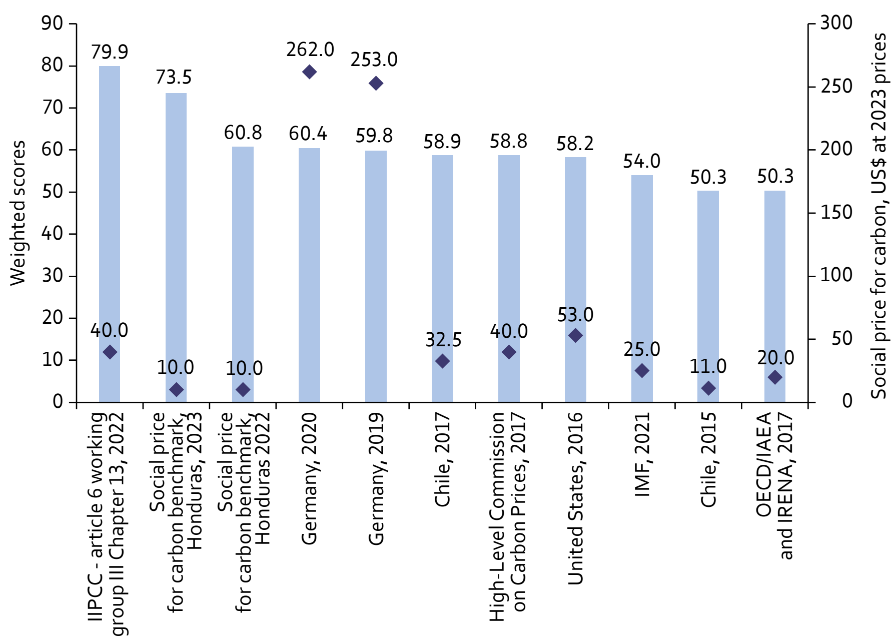
The General Directorate of Public Investments of the Ministry of Finance of Honduras is the office responsible for administering and managing the National Public Investment System of Honduras and is therefore in charge of evaluating public investment projects. At present, the country uses a 12% social discount rate in those evaluations (General Directorate of Public Investments of Honduras, 2022). Given the institutional and regulatory challenges involved in climate change management, Honduras has decided to work on including the social price of carbon as an additional element in the procedures it has been using for the social evaluation of investment projects.

Estimation of the social price of carbon in Honduras was conducted using the same evidence-based policy definition methodology as has been used by Canada, Chile and, more recently, Costa Rica. This methodology draws on the expertise and recommendations of experts from various national institutions concerning the definition of the social price of carbon. The multi-criteria analysis (MCA) estimation method was selected to facilitate the decision-making process and to obtain the buy-in of the country's public service agencies. The analytic hierarchy process (Saaty, 1980) was then applied to this MCA in order to rank the various options and reach a decision as to which should be used.

A total of 43 estimates of the social price of carbon provided by national agencies, calculated by international bodies or proposed by specialized groups were used in the calculations. The same criteria and subcriteria that were used to estimate the social price of carbon in Costa Rica Para were used here to evaluate each of the possible alternative prices (see diagram 2). The experts who took part in this work were selected by the Ministry of Finance and came from four different institutions: the General Directorate of Public Investments, the Honduran Institute of Earth Sciences, the Secretariat for Agriculture and the Central Bank of Honduras. The result of the MCA indicated that the best source to use for the social price of carbon for Honduras was the *Sixth Assessment Report* of IPCC (IPCC, 2022), which cited a value of US\$ 40/tCO_2eq (see figure 29).

This was the highest-ranked source (79.9/100 points).The source with the next-highest ranking was Benchmark 2023, with a score of 73.5/100, which recommended a price of US\$ 10/tCO_2eq. As Honduras has not yet begun to use a social price for carbon in its public investment evaluations, it decided to start out by using the price suggested by the second- and third-ranking sources (US\$ 10/tCO_2eq) and then to gradually increase the price to US\$ 40/tCO_2eq by 2030 (see table 14).

Figure 29
Scores of the highest-ranking sources for the social price of carbon in the multi-criteria analysis exercise



Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Honduras", *Project Documents*, Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024, in press.
Note: The scores used in the ranking run from 0 to 100. The figure also shows the value of the social price of carbon associated with each source in United States dollars at 2023 prices.

In most cases, once a country has defined its social price of carbon, the greatest challenge in its application is for sectoral specialists to prepare accurate projections of the level of emissions associated with the various public projects and/or policies being considered. In order to do this, the best approach is to conduct studies to identify the most meaningful types of investment projects for the country and then to develop methodologies and tools for the social evaluation of such projects by sectoral specialists. ECLAC has carried out a series of these types of studies for countries of the region concerning urban transport, inter-urban transport infrastructure, energy and other projects that can serve as a starting point for addressing forthcoming challenges in the implementation of social prices for carbon in the countries of Latin America and the Caribbean.

Table 14
Social price for carbon for Honduras for 2024–2030
(Dollars at 2021 prices per ton of CO_2)

Year	Social price of carbon
2024	10
2025	15
2026	20
2027	25
2028	30
2029	35
2030	40

Source: A. Pica and others, "Estimación del precio social del carbono para la evaluación de la inversión pública en Honduras", *Project Documents*, Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2024, in press.

IV. Conclusions and key messages

The climate crisis is compounding the economic and social crises being experienced by Latin America and the Caribbean. It can also slow the already sluggish growth rate seen over the past decade even further and heighten the problems the region is facing in the areas of productivity, energy and food security, poverty and inequality. This situation is yet another reason for stepping up the pace of climate action in the region. The challenge posed by climate change is also, however, an opportunity for spurring the regional economy's growth by galvanizing transformative sectors with the ability to contribute to GDP growth, create new formal-sector jobs, boost productivity and operate in more low-carbon, environmentally sustainable ways than their conventional fossil-fuel-dependent counterparts.

Latin America and the Caribbean have demonstrated their commitment to the Paris Agreement, but the decarbonization of the region's economies is still moving ahead at a slow pace and is far from the path it needs to be on in order to attain the objective of limiting the increase in temperature to no more than 2°C and ideally 1.5°C. In order to reach these goals, between now and 2030, Latin America and the Caribbean will need to decouple economic growth from GHG emissions at a rate between six and eight times faster than it did between 1990 and 2019.

Doing this will require thorough-going changes in the region's economy and efforts to increase flows of financing and channel investment into pivotal industries, such as the renewable energy, green hydrogen and lithium sectors needed to support the region's energy transition; electromobility, which will also help to spur urban development and improve air quality; the circular economy, which can reduce the demand for and use of materials and hence the need for foreign exchange to pay for imports; sustainable agriculture and other nature-based solutions; sustainable water management; and sustainable tourism. All of these sectors will have a major economic and social impact on the region.

In order for the region to make headway towards its climate action goals, it will need to adjust existing standards and incentives in order to alter the evaluation of the profitability of investments in ways that will place a premium on low-carbon projects. And in order to do this, existing evidence about climate risks and about how they are transmitted to the economy and the financial sector needs to be factored into the equation. This will make it possible to adjust the analysis of investment returns to reflect the actual parameters of the impact of climate change on value chains. The region also stands in need of new public policies that are consistent with the magnitude of the climate challenge; policy and regulatory frameworks that will attract investments to low-carbon sectors and assure investors of the region's commitment to resilience and carbon neutrality; and incentives and new rules for the financial system that will shift relative profitability ratios towards the above-mentioned activities and new sectors. The urgency of the situation also demands the involvement of the private sector, alongside the public sector. The private sector needs to build up its capacity for analysing climate-related financial and commercial risks and for identifying business opportunities in newly emerging production chains based on nature-positive climate action and the conservation and restoration of biodiversity.

Some of the main economic policy tools that the countries of the region can use to reduce GHG emissions are carbon taxes, ETSs, social prices of carbon and the reform of fossil fuel subsidies. These instruments provide ways of internalizing the social cost of each ton of carbon emissions. While the economic policies for reforming fossil fuel subsidies and for implementing carbon pricing are complex, they are also one and the same, as are the challenges that they must address. By the same token, the design of these instruments and their accompanying policies must incorporate compensatory measures for lower-income sectors that will be adversely affected by these policies in order to prevent their implementation from having a net regressive impact.

Although environmental taxes are in widespread use in Latin America and the Caribbean, only five countries (Argentina, Chile, Colombia, Mexico and Uruguay) are using explicit carbon pricing schemes such as carbon taxes or emissions trading systems and, even in those cases, the tax rates and/or GHG coverage are low. With the exception of Uruguay, the carbon prices being applied in the region are far below a price level consistent with the IPCC recommendations for achieving the Paris Agreement targets (between US$ 60 and US$ 120/tCO_2 by 2030 to limit global warming to 2°C and between US$ 170 and US$ 290/tCO_2 to keep it below 1.5°C). Consequently, in order to hold global warming to under 1.5°C, the countries of the region need to make greater use of carbon pricing, the prices they use have to be commensurate with the externalities associated with emissions and their coverage of greenhouse gases needs to be expanded.

In addition, implicit carbon prices, such as the social prices of carbon used in public investment evaluation systems, are being applied by only a few countries (officially in Chile, Peru and Costa Rica, although work on doing so is moving forward in the Dominican Republic, Nicaragua, Honduras, Panama and Paraguay). The application of the social price of carbon complements the use of carbon taxes and ETSs, as it makes it possible to use national budgets more efficiently in keeping with the Paris Agreement objectives.

Fossil fuel subsidies are a commonly used public policy tool in Latin America and the Caribbean. In 2023, those subsidies came to US$ 317 billion for the region as a whole, which is equivalent to 5.4% of its GDP. According to the High-Level Commission on Carbon Prices, the reduction and elimination of fossil fuel subsidies is an essential step towards carbon pricing, since, in effect, such subsidies are tantamount to a *negative* emissions price. Continuing to subsidize fossil fuel consumption not only runs entirely counter to the objectives of the Paris Agreement but also is a major drain on public finances.

During 2022, finance for climate action in the region came to US$ 58.6 billion, with that sum being almost equally split between public and private sources. There continues to be a sharp imbalance in the uses of climate finance in the region, with slightly more than three fourths of climate action finance being allocated for mitigation, while much less is used for adaptation measures. While climate financing and the use of innovative instruments in the region is burgeoning, economic and sectoral policies continue to be out of sync with climate objectives. The data on climate action finance and on fossil fuel subsidies for Latin America and the Caribbean indicate that, for each dollar invested in climate action between 2013 and 2022, US$ 9.8 was spent on subsidies for fossil fuel use. Investment in renewable energy in the region falls short of what is needed for the decarbonization of its economies. In fact, in comparative terms, Latin America and the Caribbean spent 13.3 time as much on fossil fuel subsidies in 2013–2020 as it did on investments in renewable energy.

The policy on fossil fuel subsidies thus needs to be reformed so that fuel prices will include the actual social costs of fuel use (climate change, poor air quality, accidents, traffic congestion and productivity losses) rather than only its production cost. An evaluation of the projected effects of fossil fuel price reforms in the region points to net welfare benefits. A partial reform scenario for Latin America and the Caribbean yields economic costs equal to 0.4% of the region's GDP and environmental benefits equal to 2.4% of its GDP; the net welfare benefit therefore equals 2.0% of the region's GDP, which is equivalent to US$ 141 billion. If a comprehensive reform of fossil fuel subsidies were to be carried out, the environmental benefits would amount to 3.9% of GDP, economic efficiency costs would come to 1.2% of GDP and net economic benefits would total 2.7% of regional GDP.

A partial reform of fossil fuel subsidies would boost revenues by US$ 142 billion (2.0% of the region's GDP) by 2030 relative to the baseline, while a comprehensive reform would increase the revenues of the region as a whole by US$ 231 billion (3.3% of the region's GDP) by 2030 relative to the baseline.

Subsidy reforms not only have an impact on fiscal revenues but also can modify fuel consumption trends and thus have an impact on GHG emissions. A partial reform of these subsidies in Latin America and the Caribbean is estimated to reduce regional CO_2 emissions from fossil fuels by 21% relative to the baseline by 2030, while the reduction of CO_2 emissions would amount to an estimated 31% under a full reform.

Carbon pricing tools are not enough in themselves to decarbonize the region's economies, however. The carbon taxes being used in the region are levied on the carbon content of fossil fuels, with the exception of Chile, which applies its tax to fixed-source carbon emissions. The effectiveness of carbon taxes in reducing emissions is influenced by the price and income elasticity of the demand for fuel. A meta-analysis of estimates appearing in the international literature indicates that the demand for fuel in Latin America and the Caribbean is price-inelastic in the short run, which means that demand reacts very little to price changes within that time frame. In countries where the government provides fuel subsidies, the results show that demand is inelastic in both the short and long terms, which entails obvious externalities and fiscal costs. It is therefore important to gain an understanding, not only of these elasticities, but also of their underlying structures in order to be able to devise public policies that can underpin carbon pricing in the region.

Given all the above, it is clear that finance and economic ministries have a crucial role to play in adjusting public policies to bring them more closely into line with the climate and development objectives of the countries of the region. Carbon pricing not only is a way of internalizing the social costs of GHG emissions; it is also helpful in creating the greater fiscal space needed to provide funding for social objectives and for investments in the fulfilment of the countries' climate action commitments. A reform of fossil fuel subsidies, coupled with the increased revenues afforded by carbon taxes and an upward adjustment of carbon tax rates, would help to narrow the gap in the financing needed to deliver on the nationally determined contributions of the countries of Latin America and the Caribbean.

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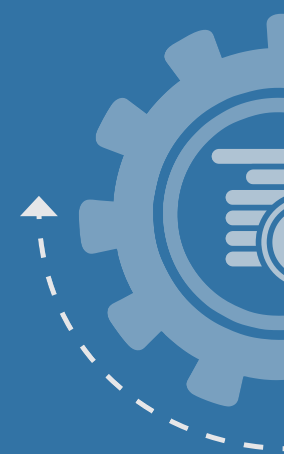
Carbon pricing is one of the public policy options for discouraging production activities and consumption patterns that generate greenhouse gas (GHG) emissions. This study provides an overview of carbon pricing in Latin America and the Caribbean, along with other associated economic policies. It reviews the situation regarding explicit carbon pricing via carbon taxes and emissions trading systems and the use of implicit pricing through the inclusion of the social price of carbon in public investment project evaluation procedures. It draws attention to the fact that very little use is being made of these pricing instruments in the region and that, even where they are in use, their coverage of GHG emissions is quite limited. What is more, the use of fossil fuel subsidies (negative carbon prices) is widespread: budget allocations for such subsidies in 2013–2022 were almost 10 times greater than the allocations for climate financing. The study also looks at two different scenarios for the reform of fossil fuel subsidization policies and what their economic, social and environmental effects would be.



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