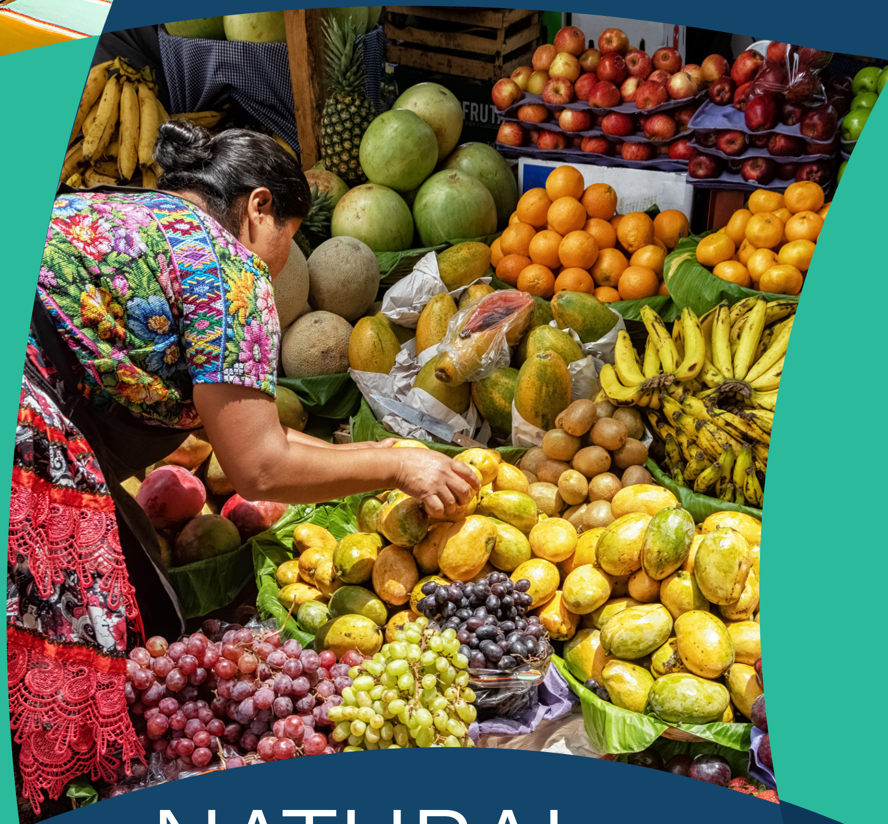

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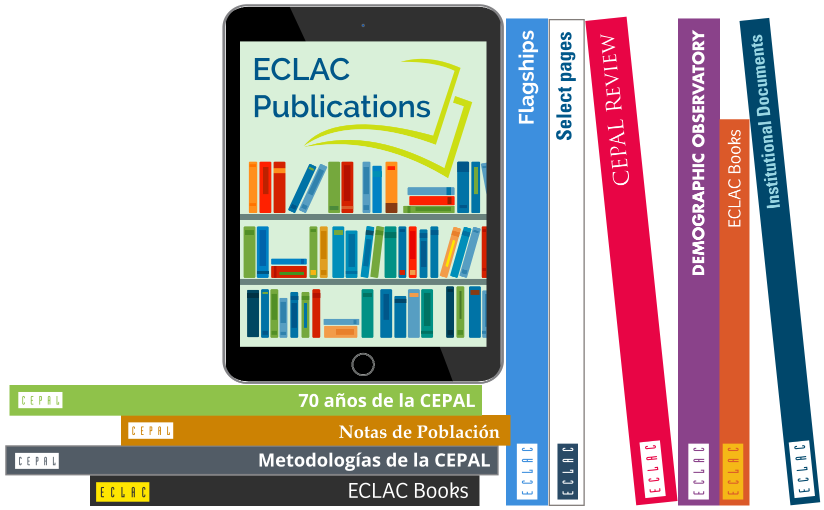

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Introduction

This issue of *Natural Resources Outlook in Latin America and the Caribbean, 2023*, examines the state of natural resources in Latin America and the Caribbean, in order to raise awareness of the role of those resources in the transition to a more sustainable development model, and foster discussion on the issue.

Latin America and the Caribbean is a region with a substantial natural resource endowment, which has been increasingly exploited for both domestic consumption and exports. Natural resources have contributed to regional economic growth and have also helped to address some social problems. However, the environmental pressure stemming from the exploitation of these resources continues and inequality persists, meaning that structural change is needed in the region's production and energy mixes.

Natural resources, renewable and non-renewable, play a key role in the region's economic development. The region is home to around 20% of all oil reserves, at least 25% of selected strategic metals and more than 30% of the world's primary forests and fresh water. In the region, natural resource-based economic activities account for 12% of value added, 16% of employment and 50% of exports. Exploitation of these resources produces considerable benefits for economies, workers, companies and governments, but also has mounting harmful effects in the territories and leads to socioenvironmental conflicts.

In the current context of cascading crises and a pressing need to step up efforts to achieve the Goals of the 2030 Agenda for Sustainable Development, it is vital to rethink how natural resources contribute to economic recovery and structural change. The region must move towards a development model that takes into account the principles of sustainability and equity. Natural resources such as water and energy have the potential to create new industries and improve the well-being of local communities, making them key factors for a transformation to more sustainable development.

In view of the above, this issue of *Natural Resources Outlook in Latin America and the Caribbean, 2023*, prepared by the Natural Resources Division of the Economic Commission for Latin America and the Caribbean (ECLAC), presents key data, observations and policy guidelines for a regional sustainable development strategy based on natural resources. The outcomes of this report are based on a combined and comparative analysis of the different types of natural resources (renewable and non-renewable), their endowment, their contribution to goods and services production, value added, employment, trade and government revenues, and the socioenvironmental impacts of exploitation of these resources in the period 2000–2021.

The document offers an in-depth analysis of central aspects, ranging from analysis of the situation of different types of natural resources to proposals for a just and sustainable energy and water transition. It also looks at the importance of biodiversity and sustainable agriculture, as well as the role of hydrocarbons and mining in the economic and ecological transformation of Latin America and the Caribbean. Over the course of its pages, some of the key issues facing the region are highlighted, along with possible solutions for a more sustainable future.

Natural Resources Outlook in Latin America and the Caribbean, 2023 represents a concerted effort by ECLAC to understand and address challenges and opportunities in this diverse and resource-rich region.

The document is divided into seven chapters.

The first chapter explores the wealth of natural resources in the region, from minerals and oil to forests and water. This lays the foundation for understanding the importance of these resources for the economy and sustainability.

The second and third chapters delve into the energy and water transition: the second chapter examines the transition to fairer and more sustainable energy sources, and the third chapter addresses the management of water, a vital resource for life and the economy, and how to make that management sustainable.

The fourth chapter looks at biodiversity and its crucial role in the transition to a sustainable future. The diversity of species and ecosystems in Latin America and the Caribbean is central to the region's social, economic and environmental resilience.

The fifth chapter discusses the bioeconomy and the agroecological transition, highlighting how sustainable agriculture, diversification and value addition in food production are key to food security and environmental sustainability.

The sixth chapter addresses the role of hydrocarbons in the economic and energy transitions. Despite the pressing need to reduce dependence on fossil fuels, these resources are still very important, particularly in the oil- and natural gas-producing economies of the region; they can contribute to these transitions through a progressive transformation.

Lastly, the seventh chapter explores the transition to a more efficient, sustainable and inclusive mining industry. The mining industry plays a significant role in the economy of Latin America and the Caribbean and this chapter discusses how it can adapt, to minimize its environmental impact and maximize its contribution to society. Among other requirements, multilevel, transparent, democratic, effective governance is important in this regard.

This document is an in-depth guide that offers a comprehensive view of challenges and opportunities related to natural resources in Latin America and the Caribbean. It provides a robust starting point for informed decision-making and policymaking on natural resources, to foster a more sustainable future for the region.

CHAPTER

I

Natural resources in Latin America and the Caribbean

Introduction

A. Natural resources and sustainable development

B. General assessment of natural resources

C. Towards a comprehensive natural resource-based strategy for sustainable development

Bibliography

Introduction

This chapter has three objectives. The first is to offer a theoretical panorama of the region's natural resources and sustainable development. The second is to provide an overview of the region's natural resources between 2000 and 2021, highlighting some key aspects and issues in the economic, socioinstitutional and environmental dimensions. The third is to set out the criteria for a comprehensive strategy for sustainable development based on natural resources.

Before embarking on the analysis, a distinction must be made between the concept of natural resources and the concepts of natural heritage and natural capital. According to Sánchez (1993), natural heritage covers the elements of nature found in a given area and the full range of natural processes that occur there. The concept includes soil, subsoil, air and water and, in more general terms, biotic and ecosystemic diversity, as well as the interrelationships between them and their capacity for reproduction and self-sustainability. In contrast, natural resources arise from human societies' manipulation of the elements and processes of nature (i.e. the natural heritage) to give them values of use and exchange. The concept of a "natural resource" therefore contains an element of usefulness, either tangible or intangible, created by applying the products of technical progress. This concept helps, first, to identify and appraise those resources and, second, to collect and transform them in accordance with the state of science and technology and prevailing life patterns.[1] Institutional development and technological capabilities play a key role in the transition from natural heritage to natural resources. Finally, natural capital is a term from economic science that groups natural resources together as a form of capital.[2] These resources are assigned an economic value that distinguishes them from the other types of capital, such as produced capital, human capital and net external assets, that make up a country's economic wealth and support the income it generates (e.g. GDP).

The first section of this chapter introduces the relationship between natural resources and sustainable development in the region. Structural problems and major environmental, economic and social challenges are discussed in light of the historical and contemporary theoretical discussions developed within the Economic Commission for Latin America and the Caribbean (ECLAC).

The second section offers a combined and comparative analysis of the different types of renewable and non-renewable natural resources in terms of different sustainable development issues, such as their volumes and the contributions they make to value added, employment, trade and public revenue. The main results of the analysis show that the exploitation of the region's significant natural resource base is not sustainable. The intensity of their use has not improved and the depletion of natural capital has continued. The weight of economic activities focused on the exploitation of these resources has fallen compared to other activities, in terms of both value added and job creation. Moreover, most of the region's countries have increased their dependence on exports of those resources, which creates productive, commercial and —especially in the most dependent countries— fiscal or budgetary inertia. There has also been an increase in the proportion of commodities in total exports (reprimarization) and a loss of productive capacities, leading not only to the export of more commodities than manufactured goods, for example, but also to higher imports than exports of

1 On this point, Sánchez (1993) recognizes that natural heritage has an intrinsic value and that its use and exchange values, which entail its manipulation and depend on technical progress, are relative and variable in time and space. Natural advantages should therefore always be treated as dynamic factors and not as static ones.

2 According to the World Bank's Wealth Accounting and the Valuation of Ecosystem Services initiative (WAVES), natural capital primarily includes resources that are easy to measure and to assign an economic value to, such as minerals, energy, forestry, agriculture, fisheries and water. It also includes the services produced by ecosystems, which are often invisible to most people and difficult to measure (and to assign an economic value to): services such as air and water filtration, flood protection, carbon storage, crop pollination and wildlife habitats, the values of which are not easily quantified in market terms.

natural resource-based manufactures. Likewise, the economic rent generated from non-renewable resources has not translated into sufficient revenue for States, which underscores the need to make tax regimes more progressive, with instruments that focus on economic rent. Together, these considerations highlight the challenges facing the region as regards the role that its natural resources must play in contributing to a more economically, socially and environmentally sustainable development model.

The third section presents the general outlines of a comprehensive strategy for natural resource-based sustainable development. It deals with issues such as the relationship between natural resources and sustainable development, the governance and management of natural resources and the role of natural resources in progressive structural change, in the big push towards sustainability and in transformative recovery in the aftermath of the COVID-19 pandemic. It also explores some thoughts about the political economy of natural resources.

A. Natural resources and sustainable development

The Latin American and Caribbean region has a rich endowment of natural resources, which are increasingly destined for both domestic consumption and exports. Those resources have made major economic contributions and have partially alleviated social problems. However, the environmental pressures caused by their exploitation have grown, a structural change in the production and energy matrices has not been achieved and inequality persists. The great challenge facing the region is to ensure that natural resources contribute more effectively to the three dimensions —environmental, economic and social— of sustainable development.

Regarding the environmental dimension, the continued specialization in primary exports, which several of the region's countries have carried over from colonial times, puts increasing pressure on the environment and on the future availability of natural resources and critical ecosystem services (such as absorption of waste and gases, the water cycle and climate). The region is losing its natural heritage and is more inefficient in its use of materials and water in GDP terms than the rest of the world. The current development model is therefore environmentally unsustainable.

In the economic dimension, the region's growth is constrained by its balance of payments (Prebisch, 1962; Thirlwall, 1979), because the income elasticity of commodities exported by the periphery is lower than the income elasticity of manufactured imports produced by the central economies. This leads to productive and technological asymmetries between the periphery and the central countries and to growing pressure from external debt and imports of manufactured products and technology, which in turn bring pressure to bear on the balance of payments (Bárcena and Cimoli, 2020). For this reason, the region faces a structural constraint that leads to increased exploitation of and trade in natural resources and poses a dilemma: without technological, economic and productive policies that improve capacities for production and innovation, primary-export production specialization will remain unchallenged and structural change will not occur (Cimoli and others, 2017).

Natural resource-related activities are also marked by a persistent duality between the extractive processes of several Latin American economies that concentrate value and do not necessarily create or increase wealth (Bárcena and Cimoli, 2020) and small producers with low levels of productivity and income. Despite the existence of innovation and an interweaving of suppliers that adapt technologies at the bottom of the natural resource chain, value addition and the corresponding economic fabric are limited. Hence the importance of promoting structural change and industrial policy, making more efficient and sustainable use of natural resources and of other sectors that can be linked to them. ECLAC has identified a number of strategic sectors with a high potential to provide a major boost to sustainability, such as renewable energies, sustainable mobility and urban spaces, healthcare manufacturing and the bioeconomy.

If there is no structural change, the unequal ecological exchange with the rest of the world will continue because the region ships out more materials, water and energy than it receives. Nor will the external technological gap be closed, and this will exert dynamic pressure on the balance of payments and perpetuate the internal structural imbalances that reproduces inequality.

In the social dimension, natural resources have generated employment and income for the population and for governments; in turn, the governments have distributed that revenue, albeit with some limitations. The unequal distribution of natural resources and of the benefits and costs of their exploitation continues to be a source of conflict, particularly among the populations of territories affected by natural resource exploitation. At the same time, the exploitation of natural resources affects the possibility of making use of other resources, such as water, biodiversity, soil and critical ecosystems. This gives rise to socioenvironmental conflicts, which tend to increase as resource exploitation intensifies.

ECLAC (2020) warns about three structural crises: (i) a social crisis, expressed in high levels of inequality, (ii) an economic crisis, seen in the low growth of recent years and the technological gap vis-à-vis developed countries, and (iii) an environmental crisis, caused by the loss of biodiversity, forests, soil and water and by rising greenhouse gas emissions. In light of that situation, ECLAC has identified an urgent need for a big push towards sustainability, so that sectoral, industrial and technological policies can be aligned and interact with each other and simultaneously reduce the economic, social and environmental gaps that exist.

Natural resources can and must play a major role in this big push for sustainability. Natural resources are not a curse; it all depends on how they are used. There is no inescapable determinism: institutions and policies can play a major role and create stable long-term coordination mechanisms among key actors, thereby encouraging investment in innovation and technological diffusion, bringing about structural changes and achieving greater productive diversification (Cimoli and others, 2015).

The strategy for using natural resources must be based on their reasonable and sustainable use. Natural resources must not be wasted on superfluous consumption; instead, they must be used for productive transformation and the well-being of the region's people, to support producers and inhabitants in the territories where the resources are found and to promote equality.

Finally, efforts must be made to initiate a socioecological transition that decouples economic growth from natural resources and from the environmental footprint (emissions, loss of biodiversity, soil, etc.), improves environmental and economic efficiency in the use of natural resources and basic and ecosystemic services, and modifies the development model through structural change in the means of production, consumption and distribution.

The following section provides a review of the environmental, economic and social dimensions of natural resources in the region and the challenges that still have to be addressed.

B. General assessment of natural resources

This section presents a diagnostic assessment of the environmental, economic and social dimensions of natural resources at the macro and sectoral levels in the first two decades of this century. It highlights the complexity of the relationship between natural resources and sustainable development as explained in the previous section.

1. Environmental dimension

(a) Natural resource endowment and flow of materials

The Latin American and Caribbean region has a significant endowment of natural resources (see table I.1). It possesses more than a quarter of the world's major metal ore reserves, almost a fifth of its hydrocarbon reserves, just under a sixth of its agricultural land and a quarter of its forest cover, almost a third of its fishing grounds and a third of its fresh water. The region is also home to a third of the world's most megadiverse countries.

Table I.1
Latin America and the Caribbean: physical endowment of natural resources
(Percentages)

Minerals	
Percentage of world reserves: • 47.0% of lithium • 36.6% of copper • 35.0% of molybdenum • 34.5% of silver • 23.8% of graphite • 20.6% of tin • 18.8% of iron • 16.7% of rare earths • 15.7% of nickel • 13.9% of zinc	Percentage of world production: • 50.8% of silver • 37.1% of copper • 36.7% of lithium • 36.5% of molybdenum • 20.9% of zinc • 20.7% of tin • 18.2% of iron • 13.9% of lead • 13.0% of gold • 9.8% of bauxite and alumina
Energy resources	
Percentage of world reserves: • 19.0% of oil • 4.3% of natural gas 11.8% of the world's total primary renewable energy supply	Percentage of world production: • 8.7% of oil • 4.5% of natural gas 97.6% of the region's population with access to electricity
Land and soil	
Percentage of global surface area: • 16% of land • 15% of agricultural land • 11% of arable land • 11% of land under cultivation	24% of the land area is protected (16% in the world) Percentage of world production or stocks: • 19% of crop output • 15% of hen stocks • 28% of cattle stocks • 10% of pig stocks • 18% of food production
Forests	
Percentage of global surface area: • 23% of forest cover • 34% of primary forest cover • 36% of forest biomass carbon	Percentage of world production or stocks: • 12% of sawn lumber production • 4% of paper production for printing and writing
Biodiversity	
• 6 of the world's 17 megadiverse countries (Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador, Mexico and Peru) • 24% of land-based ecoregions • 18% of marine ecoregions	• 40% of the capacity of ecosystems to produce natural goods and assimilate the by-products of their consumption,[a] which gives the region's inhabitants a three-fold comparative advantage in natural resources compared to the global average
Oceans	
• 31% of the fishing area	• 22% of the territorial water surface area is protected (8% in the world) • 7% of fisheries output
Water	
• 32% of renewable freshwater resources	• 75.4% of households with safely managed drinking water services • 34.0% of households with safely managed sanitation services • 12 dollars of value added per cubic metre of water extracted (SDG indicator 6.4.1) ($19 worldwide) • 45% of important sites for freshwater biodiversity are protected (40% in the world)

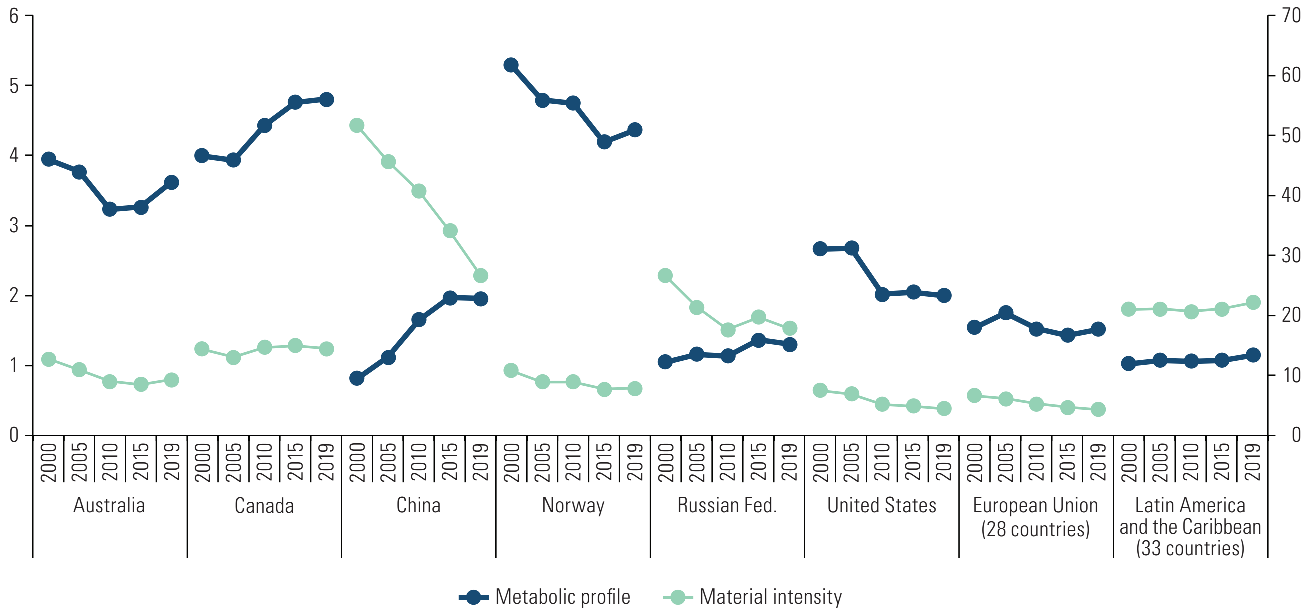
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Food and Agriculture Organization of the United Nations (FAO), AQUASTAT [online] https://www.fao.org/aquastat/en/; World Bank; BP, *bp Statistical Review of World Energy 2022: 71st edition*, 2022 [online] http://www.bp.com/statisticalreview; E. Dinerstein and others, "An ecoregion-based approach to protecting half the terrestrial realm", *BioScience*, vol. 67, No. 6, June 2017; FAO, IPBES, World Health Organization/United Nations Children's Fund (WHO/UNICEF), WHO/UNICEF Joint Monitoring Programme (JMP) Database [online] https://washdata.org/data; M. Spalding and others, "Marine ecoregions of the world: a bioregionalization of coastal and shelf areas", *BioScience*, vol. 57, No. 7, July 2007; UNSD/DESA, U.S. Geological Survey (USGS).

Note: Data for the most recent year available.

[a] Percentages for the Americas (including Canada and the United States).

Over the period analysed, the region's material intensity fell from 2.4 kg to 1.9 kg per dollar of GDP, for an average per-year drop of 1.1% between 2000 and 2019 (see figure I.1).[3] This means that significant efforts are still needed to help decouple the use of materials from the growth of the region's economies. When compared to other economies, with the exception of China, the region as a whole surpasses the others in material intensity, which indicates low material productivity and, in contrast to the situation elsewhere, the trend is getting worse. In addition, the region's domestic consumption of materials rose from 11.9 tons to 13.4 tons per capita —an average increase of 0.6% per year over the period— which also indicates a deterioration.

Figure I.1
Selected world economies: material intensity and domestic per capita material consumption, 2000, 2005, 2010, 2015 and 2019
(In kilograms per dollar of GDP at constant 2015 prices on the left scale, and in tons per capita on the right scale)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Resource Panel, Global Material Flows Database [online] https://www.resourcepanel.org/global-material-flows-database.

The material group accounting for the largest share in the region's national extraction figures is biomass, with a share that fell from 50.7% in 2000–2002 to just under 48.6% in 2017–2019. In turn, the shares of metal ores and non-metallic minerals increased over the 2000–2019 period, metal ores in particular, to reach shares close to 24% and 21%, respectively, in the final subperiod. Lastly, fossil fuels, which account for the lowest share, reported a result of just under 7% in 2017–2019 (see figure I.2). To summarize, this would indicate that the region's material productivity and environmental pressure is mostly due to domestic consumption of biomass and minerals (metal ores and non-metallic minerals) and, to a lesser extent, of fossil fuels.

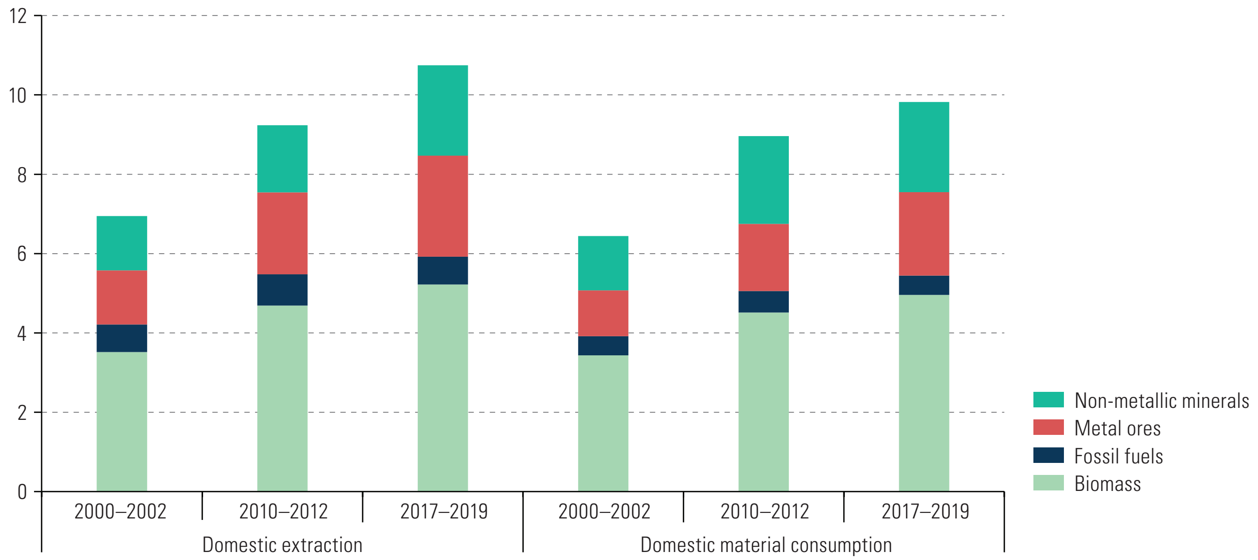
Figure I.3 shows that the net outflow of materials means that the region's physical trade balance is negative and rising, with the share of those outflows in domestic extraction increasing from 7% to 9% between 2000–2002 and 2017–2019.[4] The net

[3] Material intensity is calculated as the ratio between domestic material consumption (in kilograms) and GDP (in constant 2010 dollars), with domestic material consumption being the sum of domestic extraction and material imports minus material exports.

[4] In economy-wide material flow accounts (EW-MFA), the physical trade balance is obtained by the difference between an economy's imports and exports of materials, while the outflow of materials (exports) is subtracted from their inflow (imports).

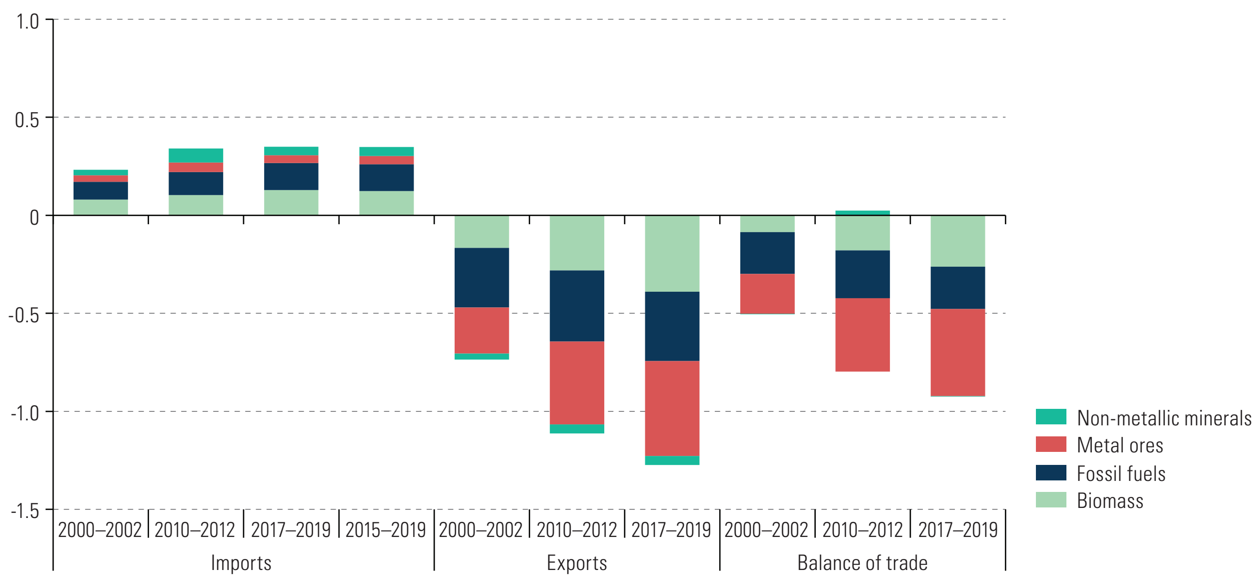
outflow of metals represented 48% of the physical trade deficit in 2017–2019, with outflows of biomass and fossil fuels accounting, respectively, for 28% and 23%. That distribution was different at the beginning of the period under study, when fossil fuels were the main material group behind the negative balance.

Figure I.2
Latin America and the Caribbean: domestic material extraction and consumption, 2000–2002, 2010–2012 and 2017–2019
(Billions of tons)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Resource Panel, Global Material Flows Database [online] https://www.resourcepanel.org/global-material-flows-database.
Note: Domestic material consumption equals domestic extraction plus imports minus exports.

Figure I.3
Latin America and the Caribbean: exports, imports and physical trade balance of materials, 2000–2002, 2010–2012 and 2017–2019
(Billions of tons)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Resource Panel, Global Material Flows Database [online] https://www.resourcepanel.org/global-material-flows-database.
Note: Physical trade balance equals imports minus exports.

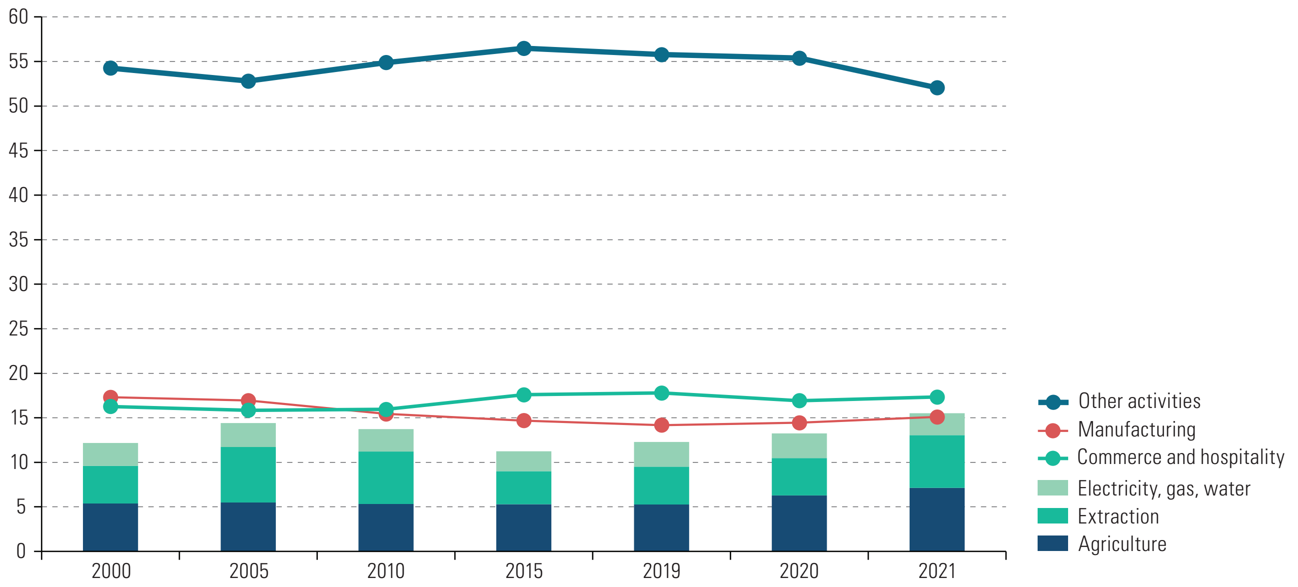
2. Economic dimension

(a) Value added

The economic activity triggered by the exploitation of natural resources can be measured by the value added by activities that involve natural resources, namely agriculture, extraction and electricity, gas and water services.[5] Together, these contributed 15.5% to the total value added of the region's economy in 2021 (at current prices). That share varied slightly between 2000 and 2021, mainly on account of the behaviour of the value added by extractive industries, where changes in fossil fuel and mineral prices and production were more pronounced. Agriculture contributed 7.1%; extractive industries, 5.9%; and electricity, gas and water, 2.5%.

Overall, over the period under review, natural resource-related activities contributed less than either manufacturing or commerce and hospitality, which posted contributions of 15.1% and 17.3% in 2021, respectively (see figure I.4). The weight of activities involving natural resources varies from country to country, depending on the type of resource, its endowment and how its exploitation is managed. For example, these activities' share of total value added in Guyana reached 39.1% in 2021, with extractive activities accounting for 21.0%. Saint Kitts and Nevis stands at the other extreme, where activities related to natural resources contributed only 3.0% of the total value added.

Figure I.4
Latin America and the Caribbean (32 countries):[a] share of activities involving natural resources in total value added at current prices, 2000, 2005, 2010, 2015, 2019, 2020 and 2021
(Percentages of GDP)

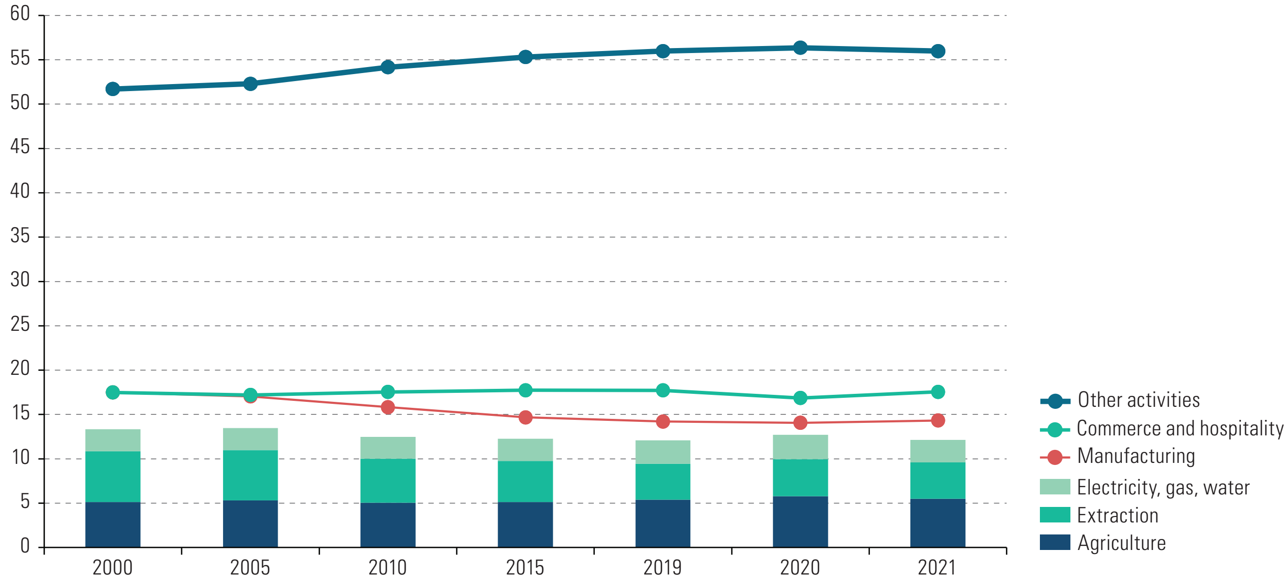


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en [accessed February 2023].
Note: Percentages of GDP at current prices.
[a] Does not include the Bolivarian Republic of Venezuela.

[5] Agricultural, extractive and electricity, gas and water activities cover the economic activities of sections A, B, D and E of the International Standard Industrial Classification of All Economic Activities (ISIC), revision 4 (United Nations, 2008).

The contribution made by the region's natural resource-related activities to total value added at constant 2018 prices fell from 13.3% in 2000 to 12.1% in 2021. This was due to the drop from 5.7% to 4.1% in the share of extractive activities in total value added, and to the small increase in the share of agricultural activities and electricity, gas and water (see figure I.5).

Figure I.5
Latin America and the Caribbean (32 countries):[a] share of natural resource-related activities in total value added at constant prices, 2000, 2005, 2010, 2015, 2019, 2020 and 2021
(Percentages of GDP)

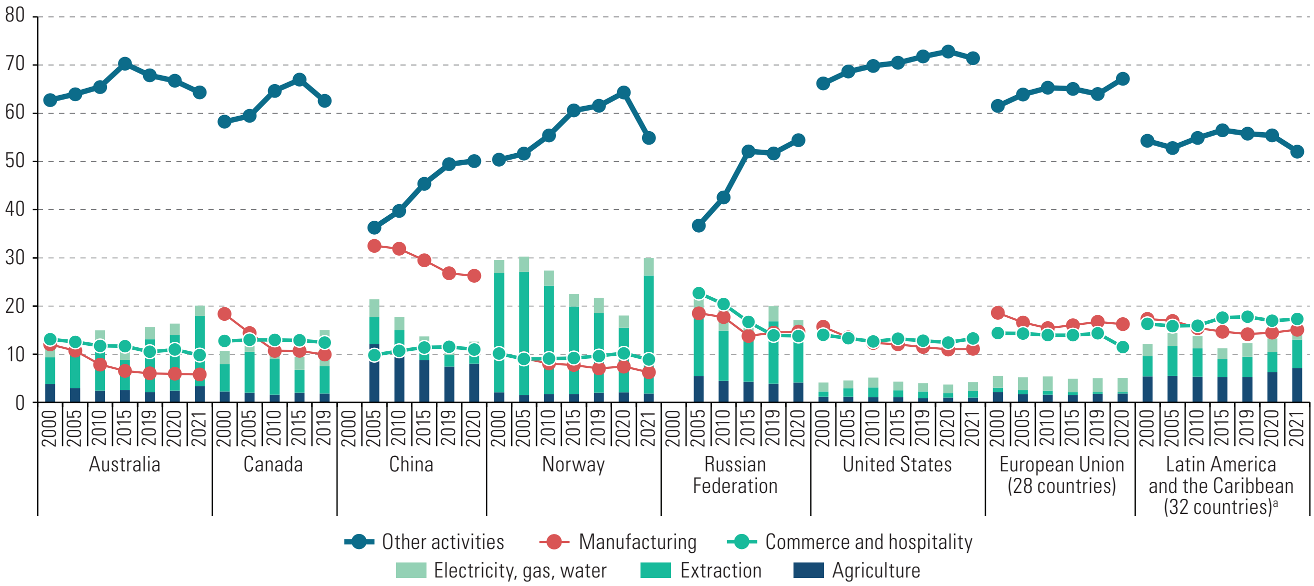


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en [accessed February 2023].
[a] Does not include the Bolivarian Republic of Venezuela.

At the same time, in the region as a whole (based on a sample of 28 countries), labour productivity increased sharply in agricultural activities (rising by 67.8% between 2000 and 2021) but fell in extractive activities (26.9%) and, to a lesser extent, in electricity, gas and water (6.2%). This trend, particularly in the case of agriculture, can be explained by more intense use of natural resources (on account of changes in land use) and of technologies for their exploitation (such as equipment and machinery) that replace labour. In the extractive sector, it can be explained by lower investment in exploration and extraction and the gradual depletion of the most profitable deposits.

In other economies with more diversified structures in more developed regions, natural resource-related activities contribute less to total value added; this is the case with the United States and the European Union. In contrast, in developed economies with long histories of natural resource exploitation, these activities make a much larger contribution to total value added; examples of this include Australia and Norway (see figure I.6).

Figure I.6
Selected world economies: share of natural resource-related activities in total value added at current prices, 2000, 2005, 2010, 2015, 2019, 2020 and 2021
(Percentages of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en; Organisation for Economic Co-operation and Development (OECD), "National Accounts at a Glance", OECD National Accounts Statistics (database), 2023 [online] https://doi.org/10.1787/data-00369-en; and data from the national statistical offices of Canada, China and the Russian Federation.

Note: Percentages of GDP at current prices.

[a] Does not include the Bolivarian Republic of Venezuela.

(b) Trade and dependence

The exercise presented below attempts to analyse the degree of dependence on trade in natural resources and to examine reprimarization in the Latin American and Caribbean region. The analysis of trade flows studies the region's 33 countries over the 2000 to 2021 period. In addition, the following economies were used as reference points for comparative purposes: Australia, Canada, China, Norway, the Russian Federation, the United States and the European Union (28 countries), some of which specialize in natural resource extraction and manufactures.[6]

In terms of its dependence on exports and imports of natural resources, the region as a whole is in the moderate range, although the trend remained on the increase over the study period, indicating a reprimarization of the economy.[7] In the case of exports, the dependence rate followed the evolution of commodity prices, but remained in the moderate range (40% to 60%) without exceeding the 60% threshold.[8] At the start of the century, between 2000 and 2002, the average rate of dependence on exports

6 Annual trade data were used, including the monetary value and net weight in kilograms of export and import flows. Mirror data were used for countries not presenting information in a given year.

7 In this context, reprimarization is understood as an increase in the relative share of unprocessed commodities in total exported goods.

8 In this document, the degree of dependence on natural resource exports is classified as very high (above 80% of total exports), high (between 60% and 80%), moderate (between 40% and 60%), low (between 20% and 40%) or very low (below 20%). Similarly, the level of dependence on natural resource imports is classified as very high (above 40% of total imports), high (between 30% and 40%), moderate (between 20% and 30%), low (between 10% and 20%) or very low (below 10%). For calculating the level of dependence on imports, the minerals group is ignored.

was 40.8% (biomass, 16.4%; fossil fuels, 15.4%; and minerals, 9.0%). During the commodity boom, taking the average for 2010 to 2012, the dependence rate increased to 57.7% (biomass, 18.8%; fossil fuels, 21.3%; and minerals, 17.5%) and, at the end of the study period, before and during the coronavirus disease (COVID-19) pandemic crisis, the average over 2019–2021 was 50.7% (biomass, 23.7%; fossil fuels, 10.0%; and minerals, 17.0%).

The degree of import dependence followed a similar pattern to exports, but remained in the low (10% to 20%) to moderate (20% to 30%) range. It did not exceed the 30% threshold, which takes into account biomass and fossil fuels but not minerals. At the start of the century, according to the average for 2000–2002, the rate stood at 19.0% (biomass, 7.3%; fossil fuels, 7.5%; and minerals 4.3%), but by 2019–2021, at the end of the period, the average was 25.7% (biomass, 7.4%; fossil fuels, 12.4%; and minerals, 5.9%). In addition, as shown on table I.2, both exports and imports of natural resources as a percentage of GDP also increased.[9]

Table I.2
Latin America and the Caribbean: degree of dependence on exports and imports of natural resources, by material group and share in GDP, 2000–2002, 2010–2012, 2016–2018 and 2019–2021
(Percentages)

Material group	Natural resource exports and GDP				Natural resource imports and GDP			
	2000–2002	2010–2012	2016–2018	2019–2021	2000–2002	2010–2012	2016–2018	2019–2021
Biomass	16.4	18.8	21.7	23.7	7.3	6.9	6.9	7.4
Fossil fuels	15.4	21.3	11.7	10.0	7.5	14.6	11.8	12.4
Minerals	9.0	17.5	14.2	17.0	4.3	5.6	5.1	5.9
Total natural resources	40.8	57.7	47.5	50.7	19.0	27.1	23.9	25.7
Natural resources/GDP	6.7	10.2	8.7	10.1	3.2	4.9	4.5	5.3

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.

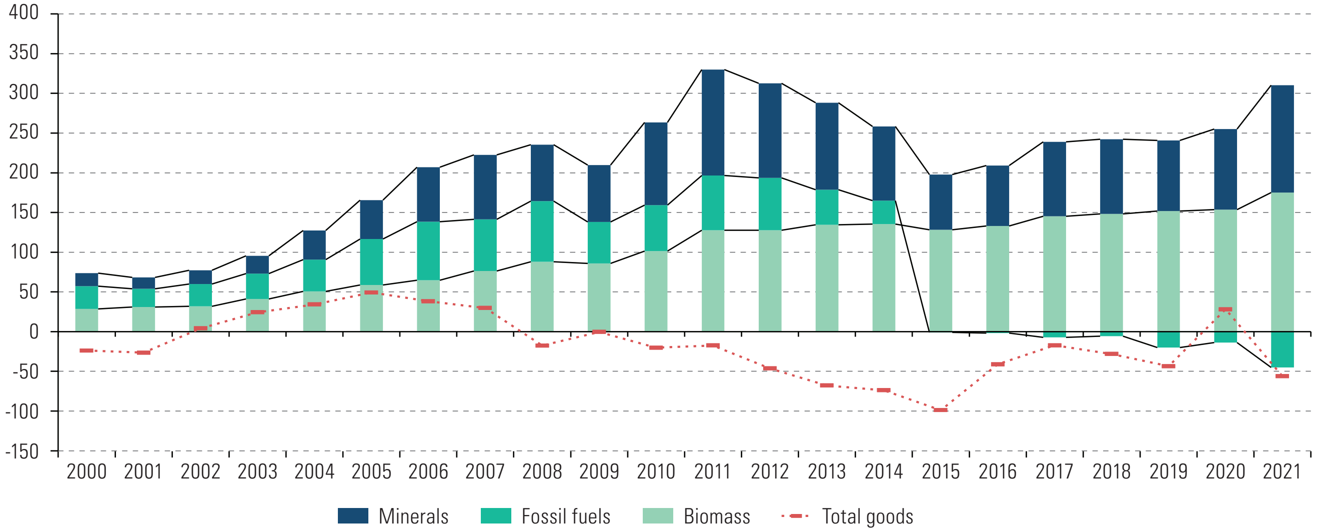
Note: Values for each subperiod are calculated as weighted averages. "Total natural resources" indicates, as applicable, the total rate of dependence on exports or imports of natural resources. "Natural resources/GDP" indicates, as applicable, the ratio between the export or import values of natural resources (according to the three material groups) and GDP.

The surplus in the trade balance for these natural resources made it possible to offset at least part of the deficit caused by imports of other products (manufactured goods of varying degrees of technological intensity). Figure I.7 illustrates this, together with the growing surpluses in trade in biomass and mineral products; it also shows how, in contrast, the fossil fuel balance turned negative from 2015 onwards. This indicates a sustained and growing pressure on both renewable and non-renewable natural resources. Table I.3 confirms the reprimarization trend, concentrated in biomass and minerals, based on the ratio of trade balances to GDP.[10]

9 The ratio of natural resource exports or imports to GDP can complement the dependence indicator in a way that strengthens or attenuates its result.

10 As regards fossil fuels, various factors contributed to lower oil and natural gas production at a time of growing energy consumption in the region, which led to increased imports of these products (those derived from oil and natural gas in particular). This is explained in more detail in the relevant chapter.

Figure I.7
Latin America and the Caribbean: balance of trade in natural resources, by material group, 2000–2021
(Billions of current dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.

Table I.3
Latin America and the Caribbean: balance of trade in natural resources and total goods as a proportion of GDP, 2000–2002, 2010–2012, 2016–2018 and 2019–2021
(Percentages)

Material	Balance of trade in natural resources and total goods			
	2000–2002	2010–2012	2016–2018	2019–2021
Biomass	1.4	2.1	2.6	3.2
Fossil fuels	1.3	1.1	-0.1	-0.5
Minerals	0.7	2.1	1.6	2.2
Total goods	-0.7	-0.5	-0.5	-0.9

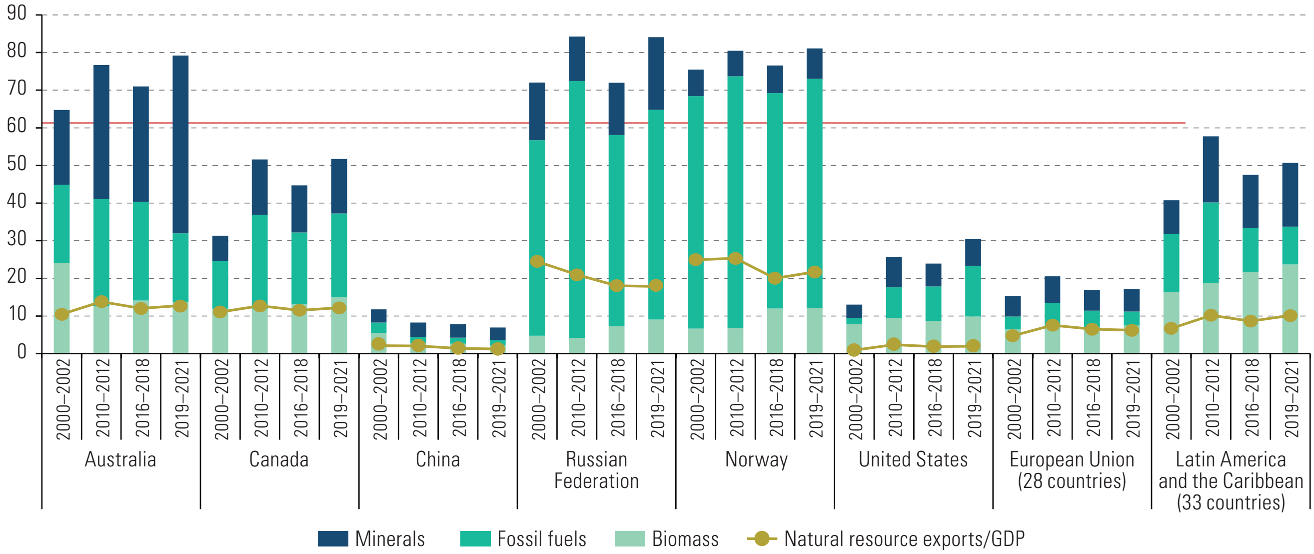
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.
Note: Values for each subperiod are calculated as weighted averages.

The natural resource trade of the region, as a bloc, can be compared with that of other economies. Australia, Norway and the Russian Federation are highly dependent on natural resource exports and, during the study period, they all maintained or increased their level of dependence. Canada, which had a low dependence at the beginning of the century, increased its dependence to the moderate level. The United States and the European Union also reported increases in their rates of dependence, but remained, respectively, at low and very low levels. China, in turn, recorded a decrease in its level of export dependence, accompanied by an increase in its dependence on imports of these resources to a moderate level. In the other economies, with the exception of the Russian Federation and the United States, dependence on natural resource imports (excluding minerals) increased, mainly on account of the increased share of fossil fuels (see figure I.8).[11]

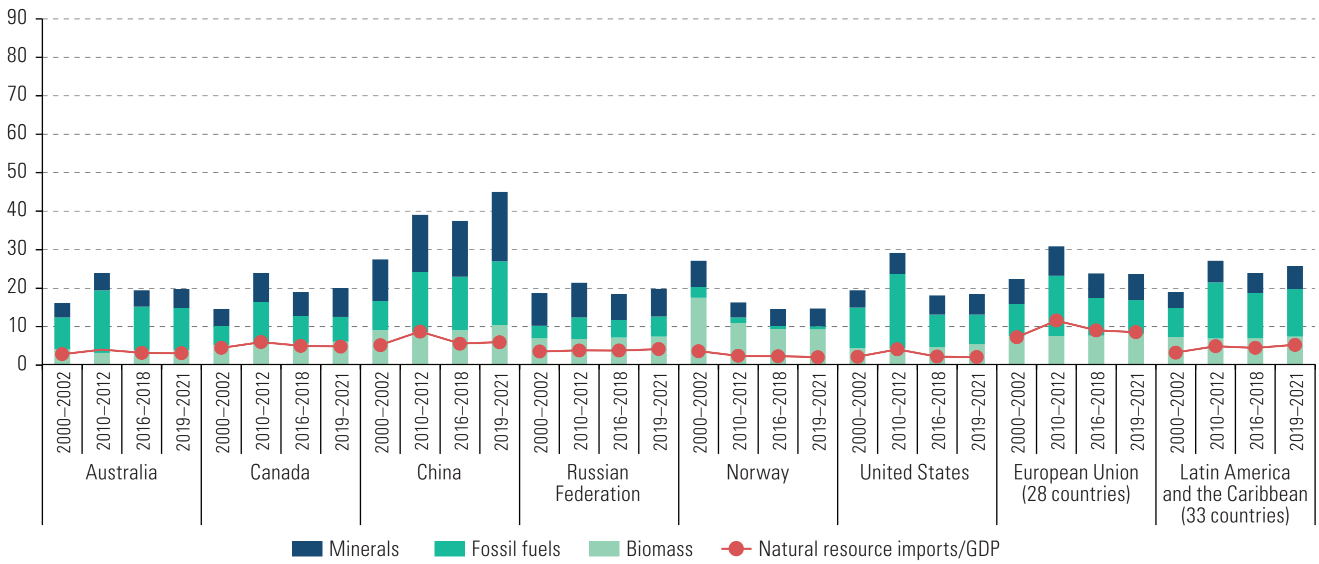
[11] Conversely, the Russian Federation and the United States reduced their dependence on natural resource imports, mainly because of their increased production of fossil fuels. More details on these changes in the production and consumption of fossil fuels in these countries can be found in the corresponding chapter.

Figure I.8
Selected world economies: degree of dependence on exports and imports of natural resources, by material group and share in GDP, 2000–2002, 2010–2012, 2016–2018 and 2019–2021
(Percentages)

A. Natural resource exports



B. Natural resource imports



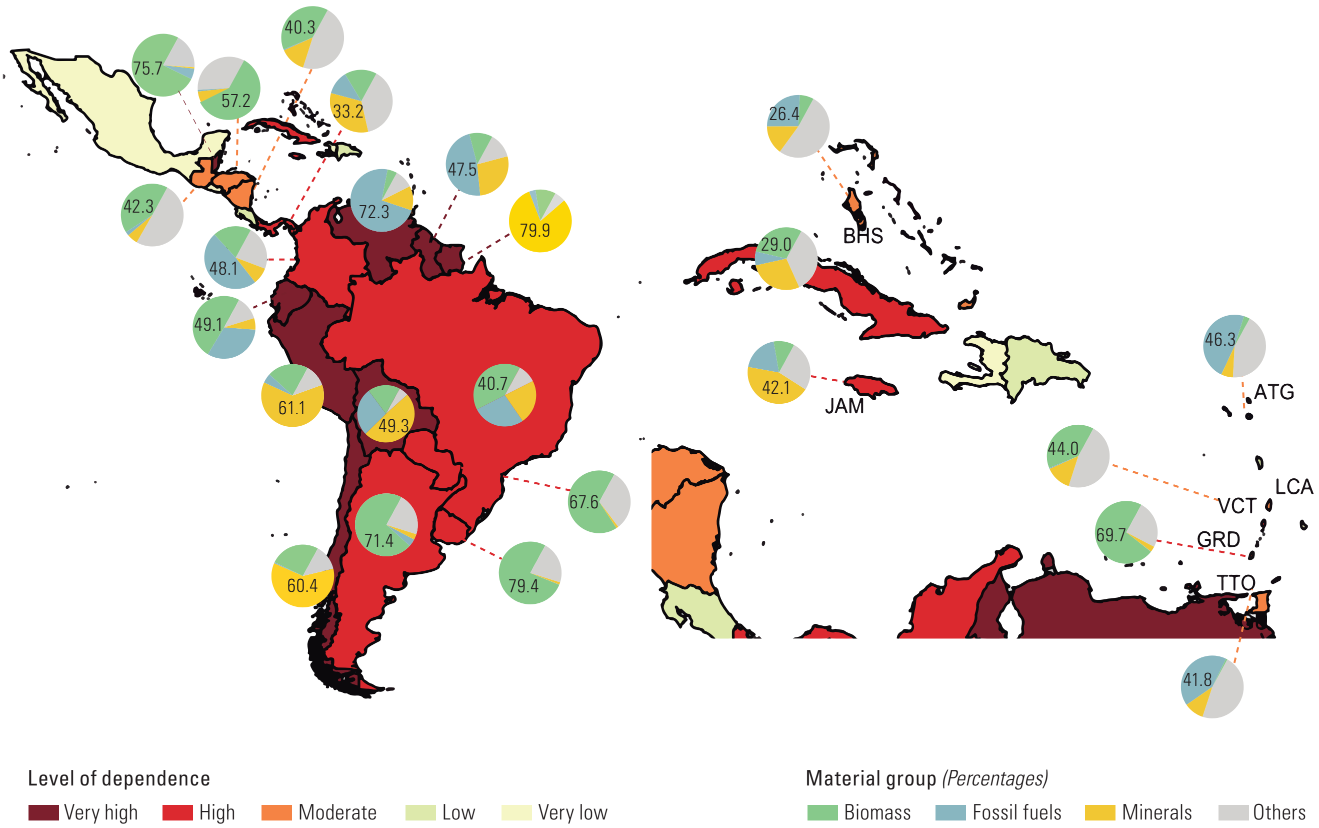
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en; United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/, and data from the World Bank.
Note: Values for each subperiod are calculated as weighted averages.

As is the case in other areas, the natural resource trade situation in the region varies greatly from one country to the next.[12] Analysing the countries by subregions reveals that all the South American countries have, at the least, a high degree of dependence on natural resource exports. Likewise, in all ten countries the trend of the indicator remained stable or increased between 2000 and 2021; this was even true in Argentina, where the weight of biomass products —its main material group— increased (and almost compensated for the fall in the share of fossil fuels). In contrast,

[12] This heterogeneity is on account of a range of factors, including the level of dependence, the distribution by material group and type of product, and the concentration of products and trading partners.

in Central America and Mexico, the degree of dependence ranged from very low to high, and the ten countries of this subregion reported different trends. Panama (with high dependence) and the Dominican Republic (low dependence) increased their degrees of dependence; Costa Rica (low), El Salvador (very low), Honduras (high) and Mexico (very low) remained stable; and Cuba (high), Guatemala (moderate), Haiti (very low) and Nicaragua (moderate) reported decreases. In the Caribbean, this indicator ranges more widely, from very low to very high, and five of the subregion's 13 countries reported increases. The Bahamas and Antigua and Barbuda (with moderate degrees of dependence) and Belize, Grenada and Guyana (all three with high or very high degrees) increased their dependence on natural resource exports. The remaining nine countries, including Jamaica (high) and Suriname (very high), either remained stable or recorded drops. To summarize, 16 of the region's 33 countries had high or very high degrees of dependence and seven had moderate degrees at the beginning of 2000. Twenty years later, in the 2019–2021 period, that total had increased: 18 countries had high or very high degrees of dependence and seven countries had moderate degrees (see map I.1).

Map I.1
Latin America and the Caribbean: degree of dependence on natural resource exports, by material group, 2019–2021
(Percentages)



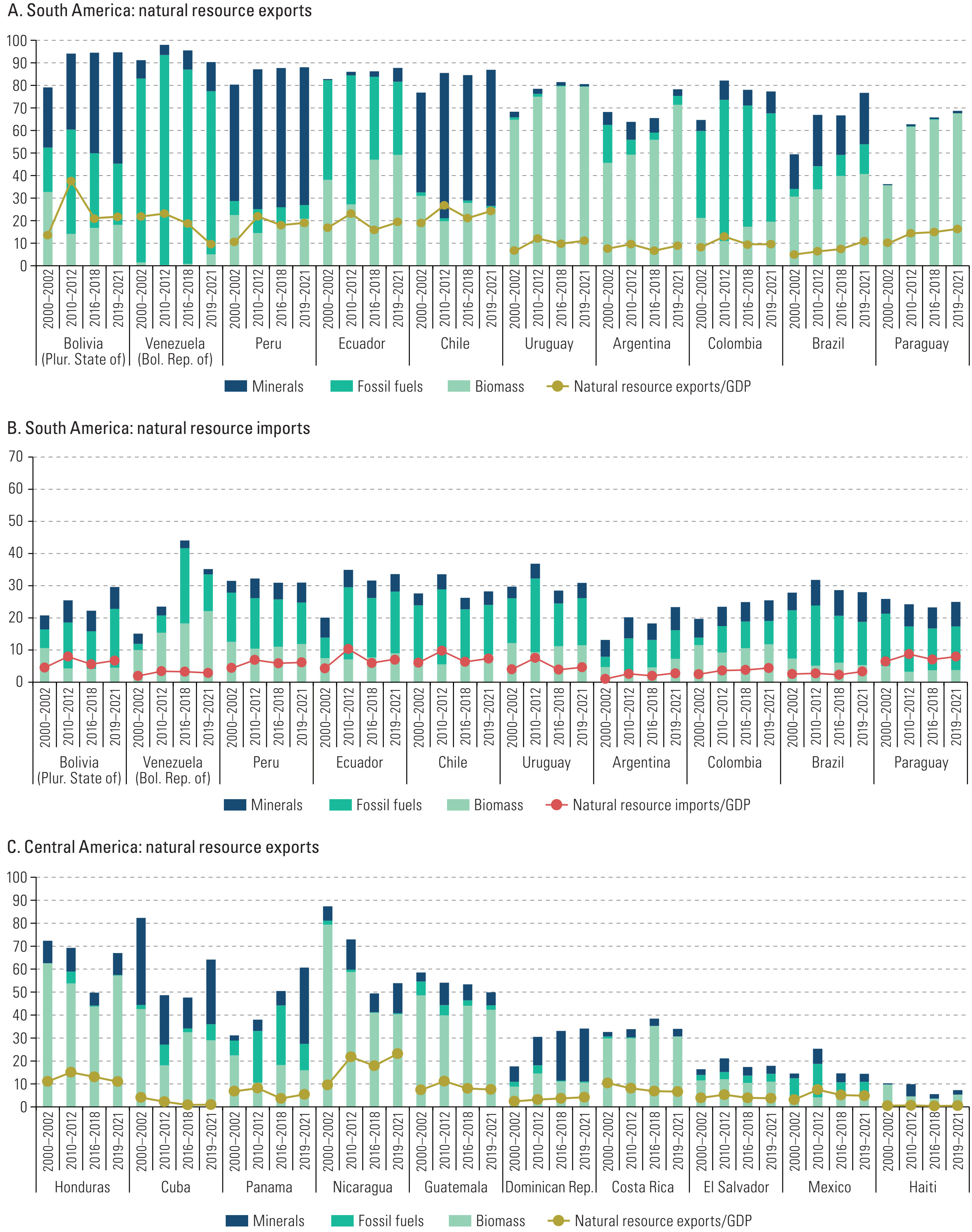
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.
Note: The share of natural resource exports in the total exports and GDP of countries with low or very low degrees of dependence over the 2019–2021 period is not shown.

There was also an upward trend in the degree of dependence on imports of natural resources (excluding the minerals group). At the turn of the millennium, only four countries reported high degrees. Then, in the 2019–2021 period, eight countries had high degrees of dependence: Antigua and Barbuda, Barbados, the Bolivarian Republic of Venezuela, Dominica, Haiti, Jamaica, Panama, and Saint Vincent and the Grenadines. Likewise, 18 of the region's 33 countries increased their dependence during the study period (see figure I.9).

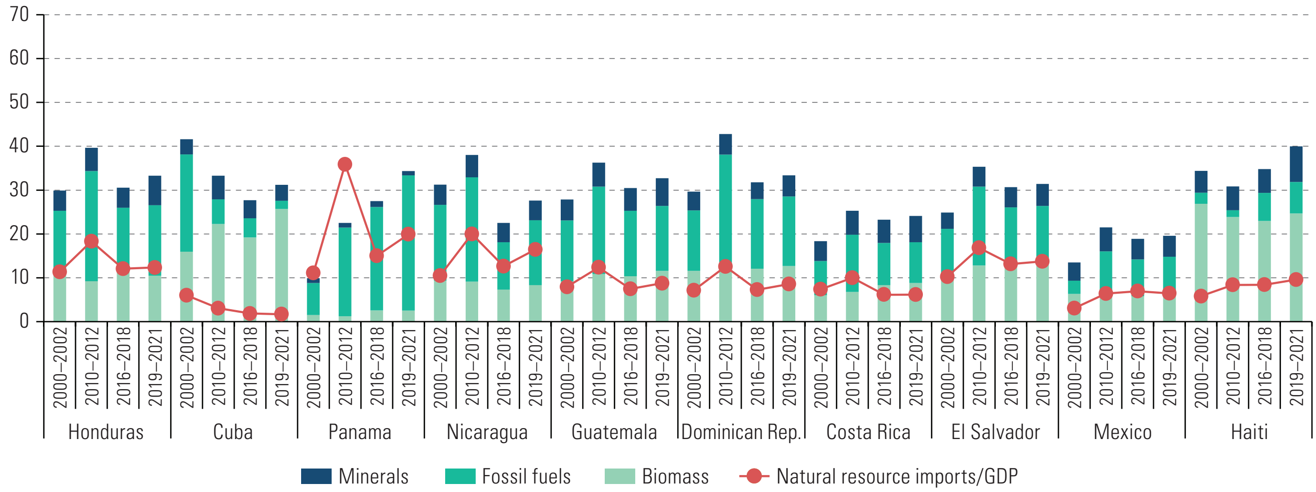
Figure I.9

Latin America and the Caribbean: degree of dependence on exports and imports of natural resources, by material group and share of GDP, 2000–2002, 2010–2012, 2016–2018 and 2019–2021

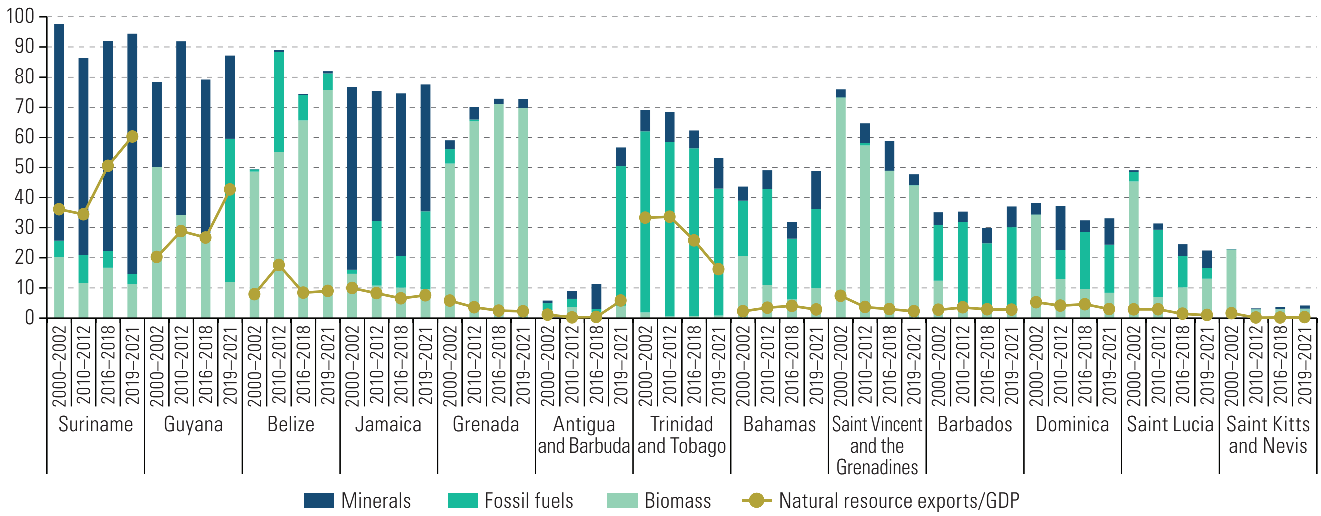
(Percentages)



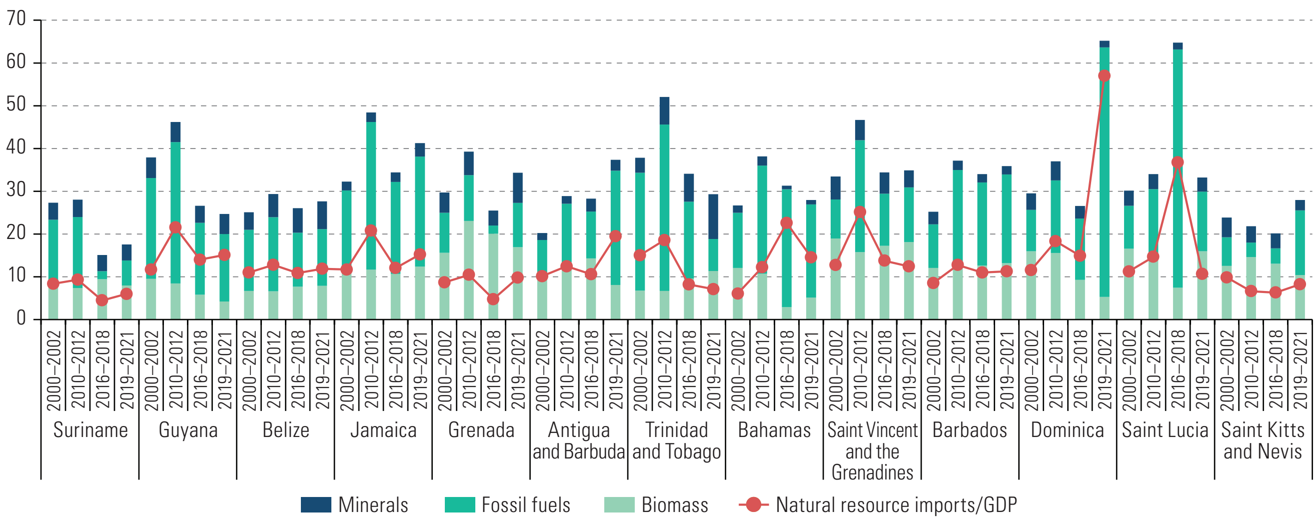
D. Central America: natural resource imports



E. The Caribbean: natural resource exports



F. The Caribbean: natural resource imports



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.

(c) Trade and technology intensity

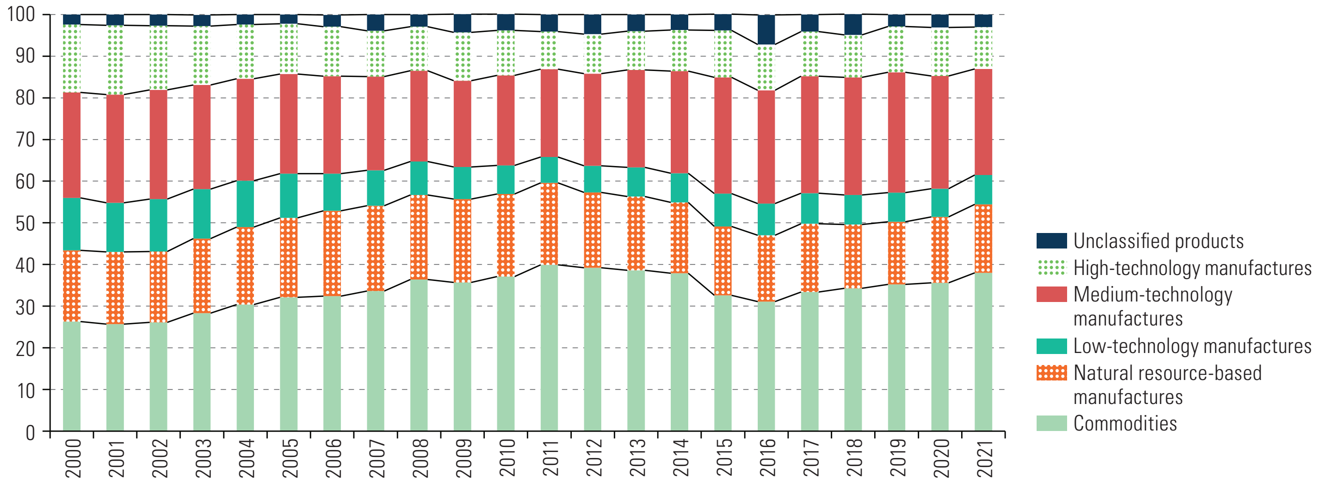
The technological intensity of an economy's trade basket can provide clues about its economic structure, productive capacities and potential for development. One indicator that reveals the level of dependence on natural resources and provides information on the technological intensity of manufactured exports is given by the classification proposed by Lall (2000), which was used, with some changes, by Durán-Lima and Álvarez (2016).[13] It categorizes natural resources as commodities, manufactures based on natural resources and, partially, unclassified products (e.g. gold powder, unwrought gold and other non-monetary forms of gold), and includes products such as prepared foodstuffs, cigars and cigarettes, alcoholic beverages, textiles and so on. This indicator complements the analysis of reprimarization by providing, according to Lall (2000), a complete map of export patterns that focuses on the technological structure of manufactured exports (thus indicating the quality of manufactured goods, as well as their quantities and distribution).[14]

Trade structures, being path-dependent and difficult to change, have implications for growth and development. The pattern of technological intensity in the region's exports confirms its moderate, albeit rising, degree of dependence on exports of natural resources. The share of commodities in the total rose from 26.0% to 36.4% between 2000–2002 and 2019–2021. In contrast, the share commanded by natural resource-based manufactures fell from 17.1% to 15.8%. Overall, they increased their share from 43.2% to 52.1% as opposed to manufactures which, grouped together (low-, medium- and high-technology), decreased their share from 54.3% to 44.9%.

On the import side, the combined share of commodities and natural resource-based manufactures also grew from 24.9% in 2000–2002 to 29.1% in 2016–2018. Unlike exports, however, it was the latter group that contributed to this growth, with an increase from 15.5% to 19.9% (see figure I.10).

Figure I.10
Latin America and the Caribbean: technological intensity of exports and imports, by category, 2000–2021
(Percentages)

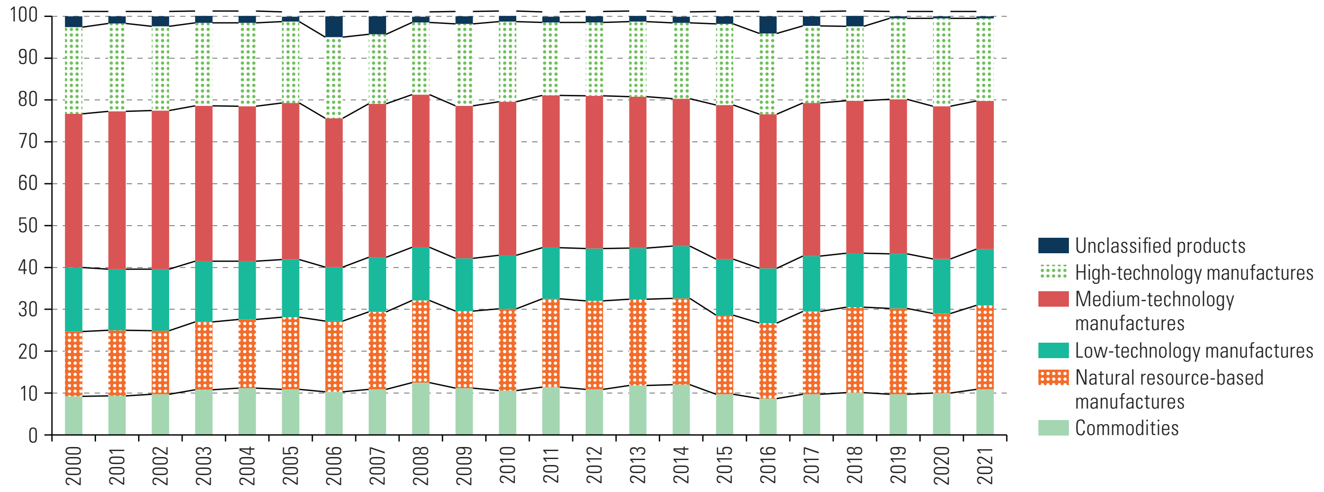
A. Exports (total goods)



[13] Lall (2000) uses with the three-digit Standard International Trade Classification (SITC), revision 2, to classify goods by their technological intensity: commodities, natural resource-based manufactures, low-technology manufactures, medium-technology manufactures, high-technology manufactures and unclassified products. The unclassified category includes, among others, gold, non-monetary (SITC code 971, which covers bullion, powdered, unwrought, semi-manufactured, waste and other forms of gold) and electricity (SITC code 351). Consideration was given to the changes suggested by Durán-Lima and Álvarez (2016): namely, that SITC 681 to 687 product groups be placed in the category of natural resource-based manufactures (and not primary products) and that SITC 281, 286, 287 and 289 be classified as primary products (and not as natural resource-based manufactures).

[14] Although the classification given by Lall (2000) is useful as a reference point, it must be noted that because of progress in biotechnology, the bioeconomy and agroindustry, the dividing lines between the primary sector, manufacturing and services are no longer so clear.

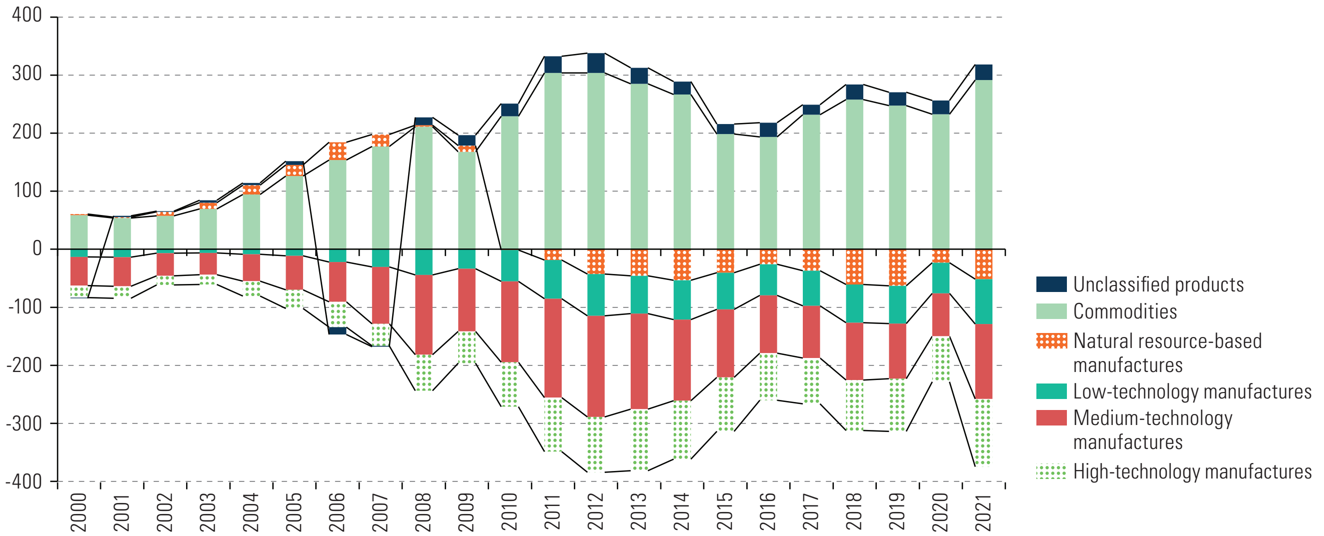
B. Imports (total goods)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.

Figure I.11 shows the trade balance between the technological intensity categories, with exports of natural resources offsetting imports of other products.

Figure I.11
Latin America and the Caribbean: evolution of the balance of trade in goods, by technological intensity, 2000–2021
(Billions of current dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.

(d) Prices and terms of trade

Commodity prices, with their short-term volatility and long-term cyclical behaviour, have an impact on terms of trade and economic rents. Countries dependent on trade in natural resources are, in different ways, the most exposed to variations in these variables. This impacts economies at both the macro and micro levels and has repercussions for government budgets and, ultimately, for the other dimensions of sustainability. Without adequate policies and instruments, the performance of natural resource-dependent countries is closely tied in with how prices evolve.

A very high level of correlation exists between commodity prices and commodity trade flows. The region as a whole reflects this association, as regards both exports and imports of natural resources.[15] Among exports, the correlation between energy prices and fossil fuel exports is almost perfect. Among imports, the highest correlation is found between agricultural prices and biomass imports (see table I.4 and figure I.12).

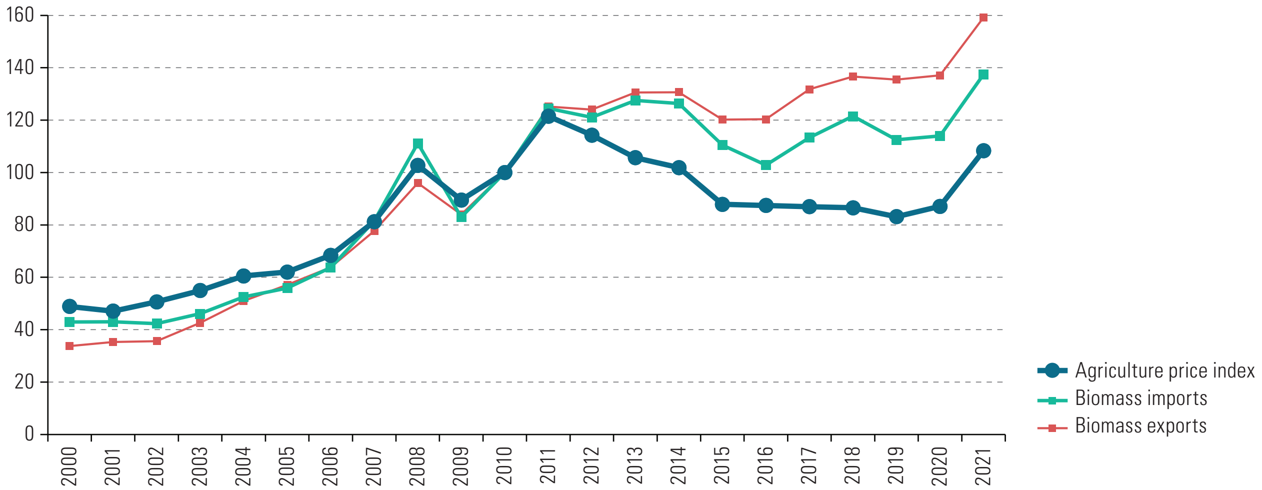
Table I.4
Latin America and the Caribbean: correlation between commodity prices and trade flows, by material group, 2000–2021
(Percentages, index 2010=100)

Price index	Exports			Imports		
	Biomass	Fossil fuels	Minerals	Biomass	Fossil fuels	Minerals
Agriculture	0.84			0.92		
Energy		0.98			0.87	
Minerals			0.91			0.89

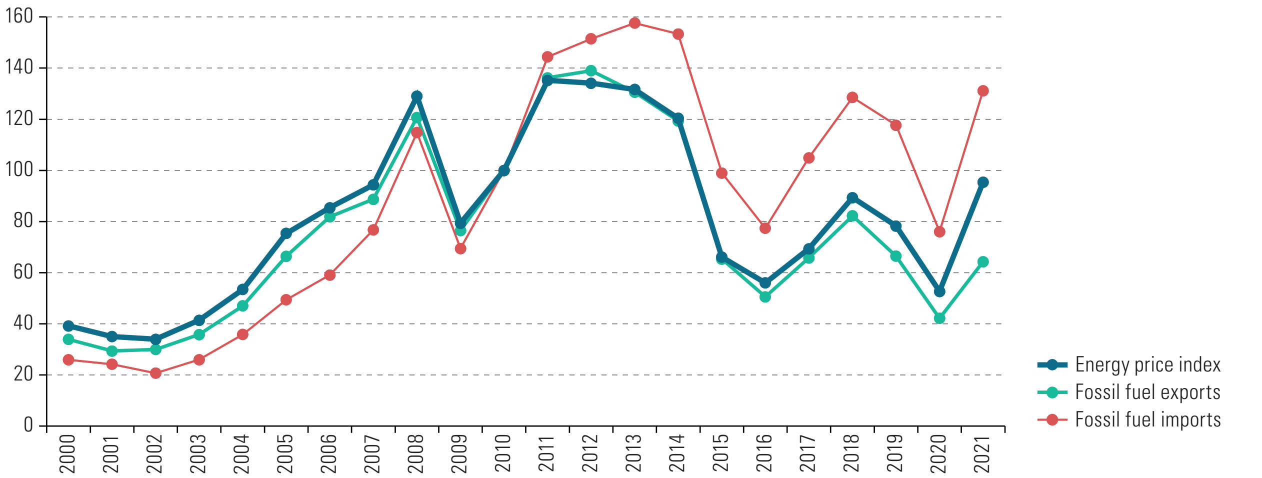
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/ and data from the World Bank.

Figure I.12
Latin America and the Caribbean: evolution of natural resource exports and imports compared to commodity group price indices, 2000–2021
(Index 2010=100)

A. Biomass

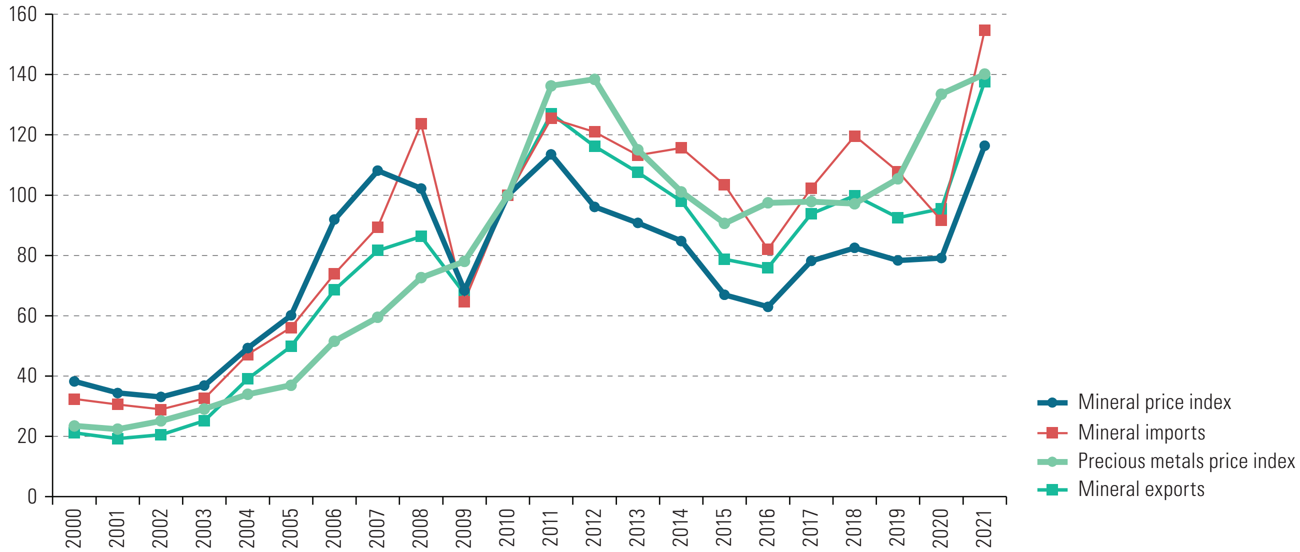


B. Fossil fuels



[15] The statistical significance of the correlation coefficients was calculated, and, in all cases, the no relationship hypothesis was rejected.

C. Minerals



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/ and data from the World Bank.

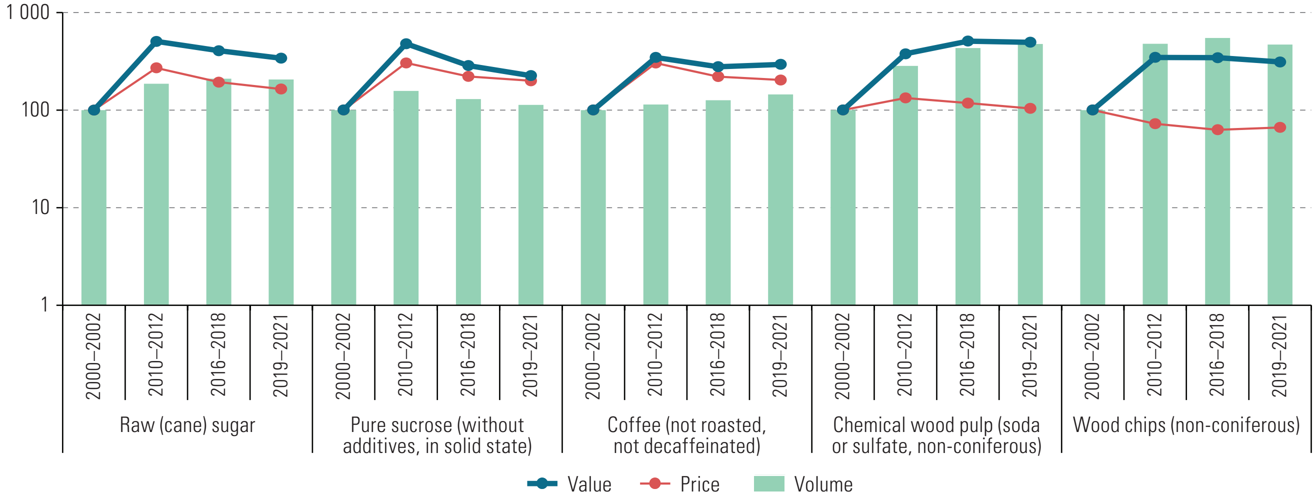
The trend of the natural resource export and import indices over commodity price indices from base year 2010 onwards —with the exception of fossil fuel exports— explains the region's underlying productive and trade inertia and dependence on fossil fuels. After the commodity boom, falling prices and policy incentives were not enough to drive structural change in production and trade. To test this, 20 products were selected that together represent 66.6% of the value and 81.3% of the volume of the region's natural resource exports over four subperiods.[16] If the 2019–2021 and 2010–2012 periods —i.e. in the aftermath of the boom— are compared, 10 of the 20 products in the sample saw their volumes decrease. In addition, five of them saw their average price (or unit value) contract at a faster rate (as was the case with coal, crude oil, refined oil/oil products, wheat and wood chips); in contrast, the unit value of five mineral products remained the same or continued to rise. Similarly, since the start of the millennium, the exported volumes of 15 of the 20 products rose while those of the remaining five decreased; however, for three the contraction occurred in the most recent subperiod (crude oil, salt and pebbles) and, for the other two, it began years before (refined oil/oil products and unwrought gold). This situation not only evidences the productive inertia and difficulties of some industries (such as the hydrocarbon industry), but also the increased pressure on natural resources and the impact that this entails in terms of the dimensions of sustainability (see figure I.13).[17]

[16] The 20 products selected for their representativeness, in terms of value and volume in the 2000–2002, 2010–2012, 2016–2018 and 2019–2021 subperiods, belong to the six-digit Harmonized Commodity Description and Coding System (HS), 1996 revision.

[17] Some of the impacts are described in this chapter, but others are described more specifically —and, in some cases, more extensively— in later chapters.

Figure I.13
Latin America and the Caribbean: evolution of price and export values and volumes for 20 selected products, 2000–2002, 2010–2012, 2016–2018 and 2019–2021
(Logarithmic scale, index 2000–2002=100)

D. Sugar, stimulants and spices, and wood pulp



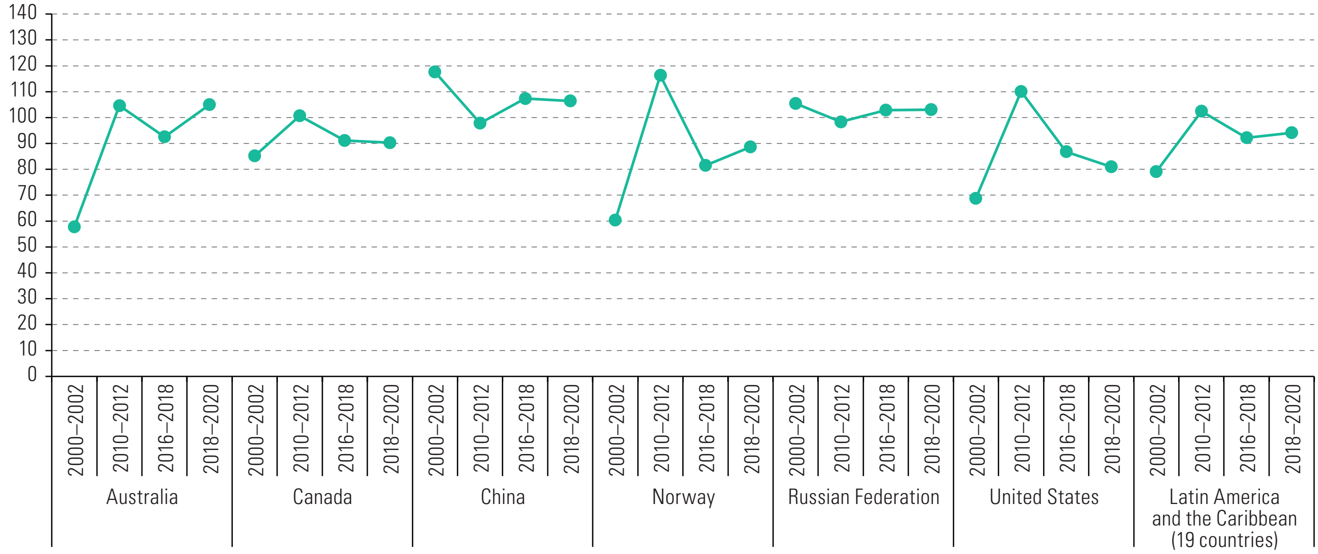
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.
Note: The calculated product price is the unit value resulting from dividing the free on board (FOB) dollar value by the net weight (using, in most cases, the kilogram as the unit of mass).
[a] The mineral product groups are non-ferrous metals, iron and steel, precious metals and industrial minerals.

Commodity prices trended upwards sharply until 2011 for agricultural produce, until 2011–2013 for energy and until 2012 for minerals. The price trend then changed and began to fall: gradually for agricultural prices and more rapidly for energy and minerals, although the latter two groups experienced a recovery from 2016 onwards. After 2018, however, due to increasing global uncertainty, commercial and hegemonic rivalry and the onset of COVID-19 —with the impact it had on supply chains and the repercussions of containment measures on supply and demand— commodity prices, with the exception of precious metals, began a further sharp decline in 2020. In contrast, during 2021, as vaccination plans became effective, containment measures were lifted and economies revived, a rapid recovery in the global economy led to significant increases in commodity prices. Most outstripped their pre-pandemic levels. This situation with commodity prices was further exacerbated in 2022 by the conflict between the Russian Federation and Ukraine, which led to a global energy crisis and generalized price rises in most countries around the world.

This means that, on average, over the period analysed between 2000 and 2020, the region benefited from the evolution of the net terms of trade.[18] In general, countries with a higher degree of dependence on natural resource exports saw improvements in this indicator, which translated into more favourable levels of relative purchasing power. This happened in the region as a whole and in several of the reference economies with some degree of dependence (from low to very high); it was particularly the case in Australia, which increased its net terms of trade in the final subperiod. In contrast, in China and the United States (both of which have very low levels of dependence and export baskets focused on more technology-intensive manufactures), the evolution was unfavourable. Nevertheless, China's net terms of trade at the end of the period were still above those of the group with favourable results. The United States reported a sharper decline after the commodity boom, when the country benefited from the price cycle (see figure I.14).

[18] The net terms of trade index shows the relative evolution of the prices of a country's exports and imports. It is calculated as a percentage ratio by dividing the unit value of goods exports by the unit value of imports.

Figure I.14
Selected world economies: net terms of trade index, 2000–2020
(Index 2010=100)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and data from the World Bank.
Note: The indices for each subperiod were calculated as the simple average of the indices for each year.

(e) Economic rent and government revenues

Economic rent from natural resources, especially non-renewable ones, plays an important role for countries that specialize in them. Higher economic rent potential is associated with greater endowments of natural resources, so countries with higher reserves are expected to have higher levels of rent, at least in the short term. Commodity prices also influence the economic rent earned from natural resources:[19] it will rise or fall as commodity prices increase or decrease with respect to average production costs.[20]

The World Bank's calculation of economic rent from natural resources (Lange, Wodon and Carey, 2018) provides an approximation of the evolution of the surplus between international prices and average production costs for some of these non-renewable resources.[21] In the region, economic rent from fossil fuels (coal, natural gas and oil) in general declined over the period analysed, which would indicate that the relative advantages of lower production costs or greater feasibility of resource extraction were attenuated.[22] In contrast, rent from forestry improved, as did, more particularly, rent

19 Economic rent can be explained as the surplus income that can theoretically be taken away from an investor without altering his economic behaviour. For a more detailed definition and analysis, see Otto and others (2006).

20 In the long term, in addition to variable production costs, the cost of invested capital (including sunk costs) and a competitive rate of return on that capital must be considered. Thus, long-term economic rent is the difference between the market price and the average total cost of production. This is called pure rent and is significantly lower than short-term rent; it may even be marginal or non-existent (Otto and others, 2006).

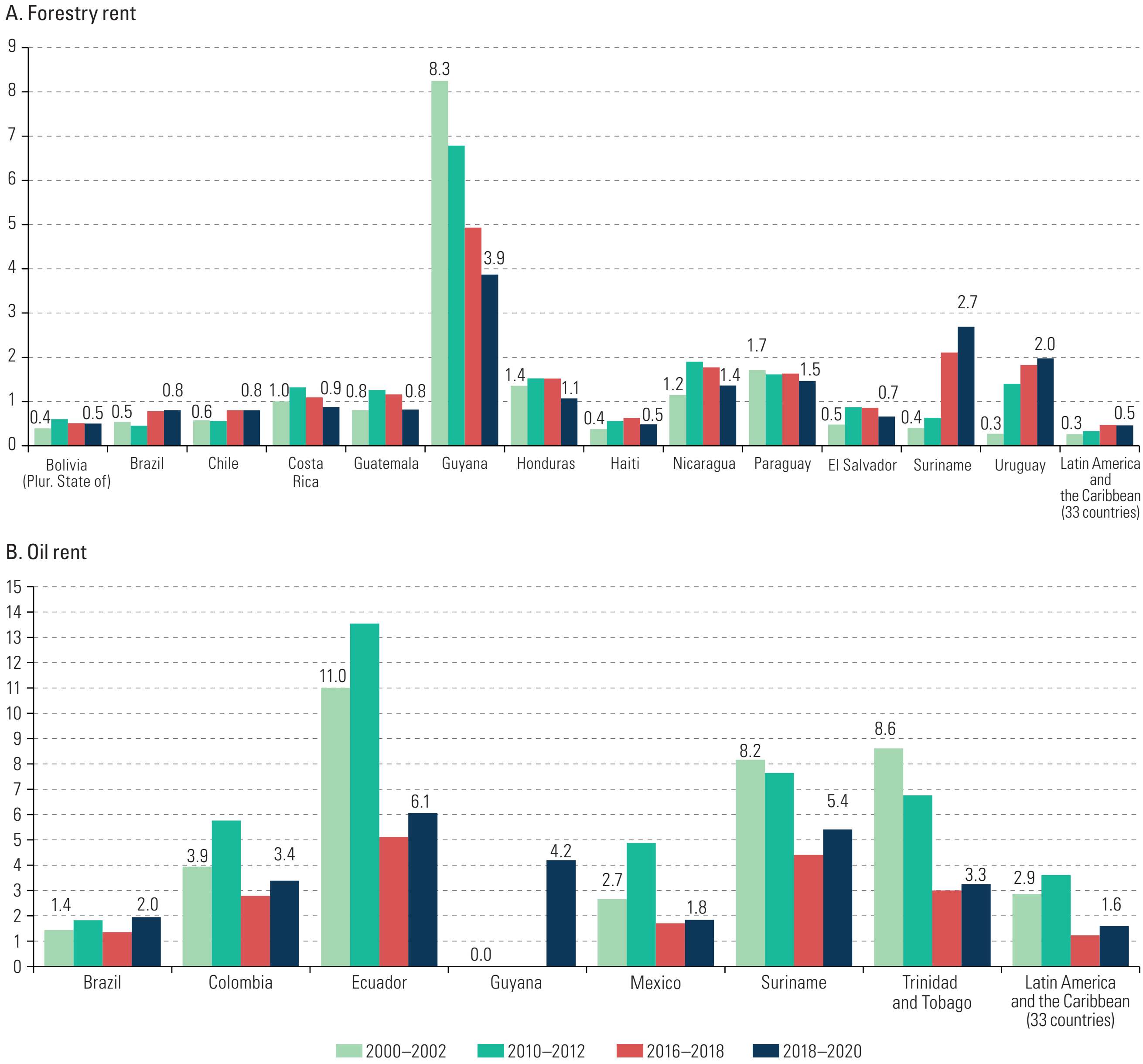
21 It should be noted that the World Bank's economic rent estimates include a "normal" rate of return on fixed capital, but, being based on an average of long-term global returns, do not reflect country-specific risk premiums that may be necessary to compensate investors for investing in certain countries (Lange, Wodon and Carey, 2018). Moreover, economic rent is not restricted to extractive industries; instead, it is found wherever a fixed factor of production exists: in agricultural land, forests, fisheries (both cultivated and natural) and hunting grounds. It is also present on land that is being developed for housing: as cities grow, owners of properties in the central area or with attractive public services (transit, parks, etc.) obtain economic rent as property values skyrocket (Otto and others, 2006).

22 A lack of investment, the characteristics of the extractable resource, its cost structure, the end of the commodity boom and falling international prices are among the elements that explain the decrease in these resources' rent and the increase in imports of those goods in some of the region's producing countries. The chapter on fossil fuels discusses the factors behind those developments in greater detail.

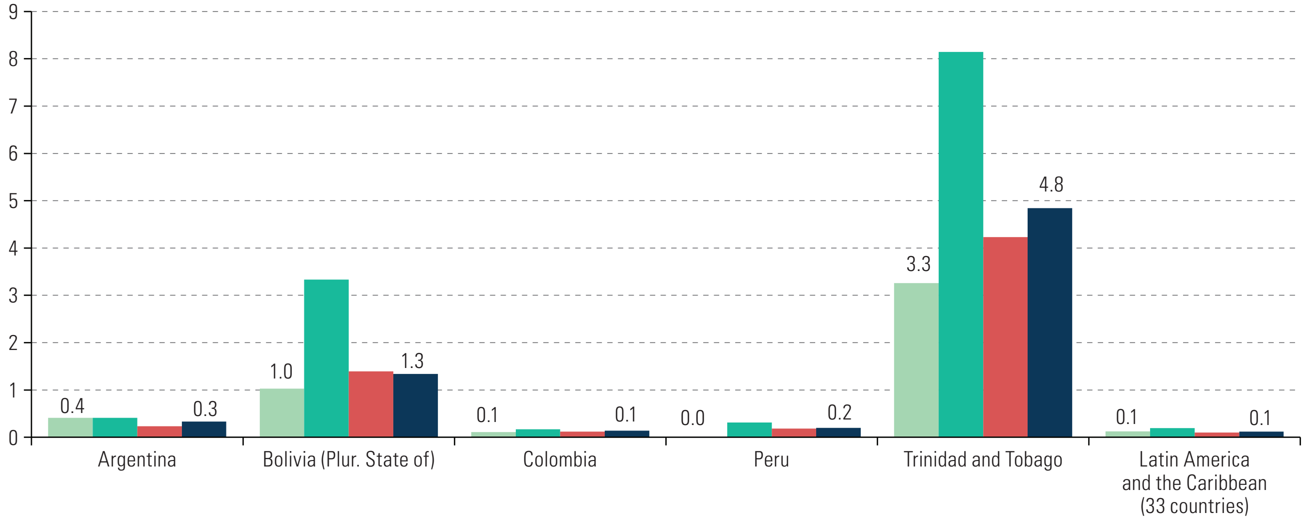
from minerals. This dissimilar behaviour underscores the fact that while international commodity prices have a direct impact on economic rent, they are not the only factor to be considered. Investment (in exploration, technology, development and innovation) and its promotion are essential for exploiting natural resources, improving productive processes, reducing direct and indirect costs (externalities) and generating economic rent.

Figures I.15A, I.15B, I.15C and I.15D show the countries that received economic rent at proportions of GDP above the regional average between 2000 and 2020 and, in each case, how that rent evolved. The drop from 2.9% to 1.6% of GDP in oil rent between 2000–2002 and 2018–2020 is particularly notable. At the same time, forestry and mining rents rose from 0.3% to 0.5% of GDP and from 0.3% to 0.9% of GDP, respectively, between the two subperiods.

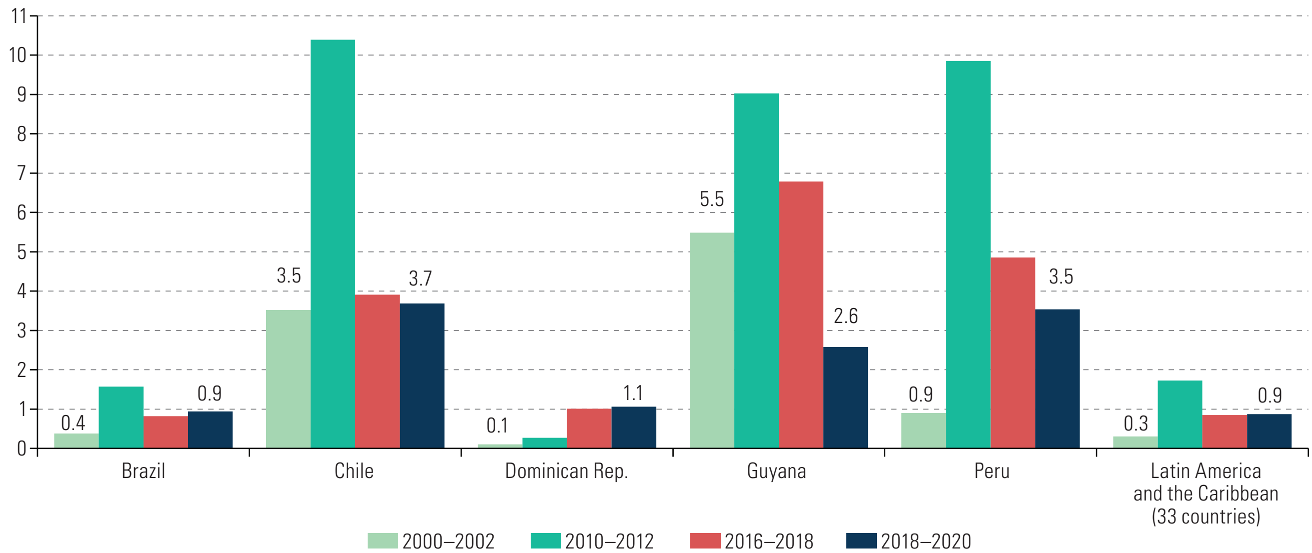
Figure I.15
Latin America and the Caribbean and selected countries: natural resource rents as a percentage of GDP, 2000–2002, 2010–2012, 2016–2018 and 2018–2020
(Percentages)



C. Natural gas rent



D. Mineral rent



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.

Note: The figures show the countries that had average rents in excess of the weighted average for Latin America and the Caribbean. The percentage of rent in each economy's GDP over each subperiod was calculated as the simple average of the percentages for each of the years. Rent data for the Bolivarian Republic of Venezuela in 2016–2018 are not available.

Public revenues from the exploitation of natural resources depend on the government's ability to secure part of the economic rent obtained from those resources. This relationship between public revenues and economic rent (the government take) depends not only on the tax regime, its instruments, the adequacy of its design or the efficiency with which it is enforced, but also on the physical availability of natural resources and their prices, investment and production. In the case of non-renewable subsoil resources, such as fossil fuels and minerals, the special tax treatment assigned to them compared to other activities (industries or sectors) can be justified.[23] Governments face the challenge

[23] Two basic principles are generally used to justify this: ownership, since they are public domain exhaustible resources that belong to the State, and the characteristics of the activity itself, involving high sunk costs, substantial levels of economic rent, extreme uncertainty, significant information asymmetries, considerable market power, potential for the development of linkages and so on (Otto and others, 2006; Gómez Sabaini, Jiménez and Morán, 2015).

of designing the fiscal regime and selecting the instruments applicable to extractive activities in a way that strikes a balance between the need to maximize public revenues derived from those activities and minimize the disincentives this causes for economic agents engaged in exploration and production.

During the study period, public revenues earned through the exploitation of non-renewable natural resources in the region behaved differently depending on the extractive activity in question and the country involved.[24] First, revenues from hydrocarbon extraction saw their share of GDP fall (from 1.5% in 2000–2002 to 1.4% in 2019–2021), together with their share of total revenue (from 7.7% to 5.3%). This was because rent from this activity trended negatively against energy prices and, in addition, because there was a drop in fossil fuel production (particularly oil), which led to greater imports of energy products. However, it can be seen that public revenues remained close to the level of economic rent and followed its trajectory.[25] The degree of appropriation and progressivity was probably high, likely on account of the significant participation of State-owned companies in the activity.[26] This allows governments to capture economic rent either directly (by collecting dividends or profit transfers) or indirectly (by collecting taxes). This direct revenue, together with income from royalty payments, make up the non-tax revenues that accounted for an average of about 92% of the revenues collected from the activity in 2019–2021, up from 89% in 2000–2002 (see table I.5 and figure I.16).

Table I.5
Latin America and the Caribbean (selected countries): government revenue from fossil fuel and mineral extraction as a proportion of GDP and total government revenue, 2000–2002, 2010–2012 and 2019–2021
(Percentages)

Ratio	2000–2002	2010–2012	2019–2021	Ratio	2000–2002	2010–2012	2019–2021
Hydrocarbon revenue/GDP	1.6	2.4	1.4	Mineral revenue/GDP	0.1	0.4	0.4
Hydrocarbon revenue/TR	7.7	8.9	5.3	Mineral revenue/TR	0.3	1.6	1.5
Hydrocarbon rent/GDP	2.5	3.3	2.1	Mineral rent/GDP	0.3	1.9	0.9

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and data from the World Bank.

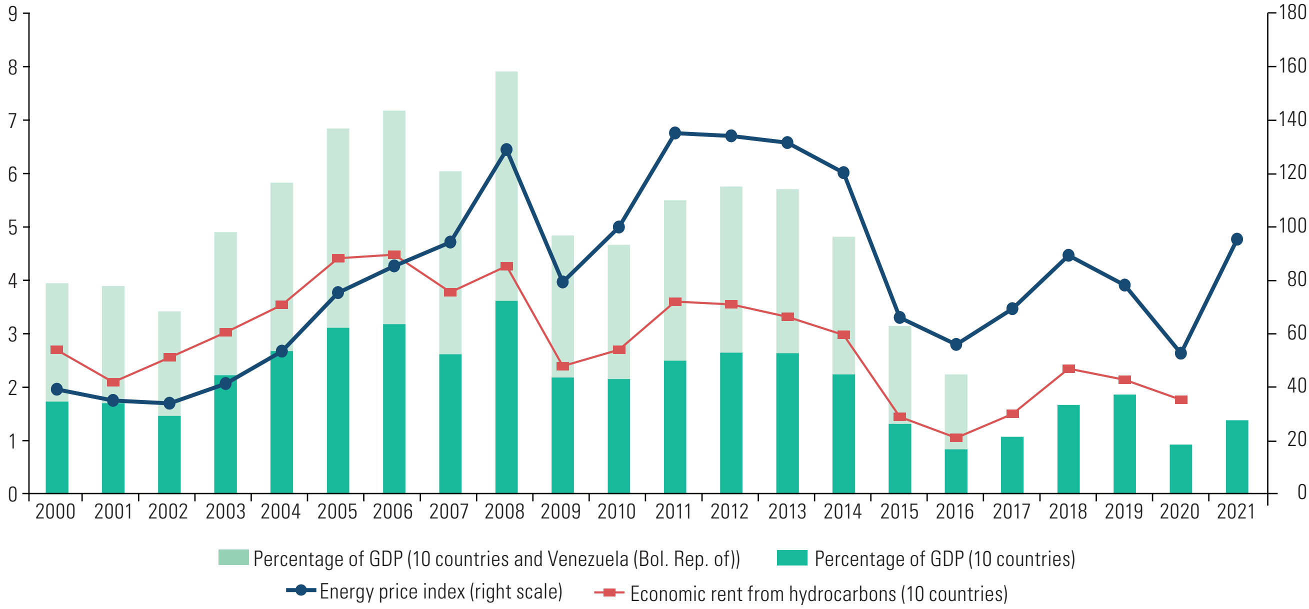
Note: The ten countries selected to determine the weighted average of the region's public revenue from hydrocarbons were Argentina, Brazil, Colombia, Ecuador, Guatemala, Guyana (from 2020), Mexico, Peru, the Plurinational State of Bolivia and Trinidad and Tobago. Hydrocarbon economic rents are expressed as the weighted average of the natural gas and oil rents of the ten selected countries. The 12 countries selected to determine the region's weighted average public mineral revenues were Argentina, Brazil, Chile, Colombia, the Dominican Republic (since 2012), Ecuador (since 2006), Guatemala, Jamaica, Mexico, Nicaragua (since 2004), Peru and the Plurinational State of Bolivia. Mineral economic rents are expressed as the weighted average of the mineral rents of the 12 selected countries. The abbreviation TR refers to total public revenues.

24 A sample of countries was used to conduct the analysis of the region as a whole. The region's countries differ as regards their fiscal regimes, instruments and performance, which gives rise to varying levels of tax burdens, government take and fiscal dependence (Gómez Sabaini, Jiménez and Morán, 2015).

25 The relationship between these two variables provides an approximation of government take. Because of the different sources used and the absence of data series and methodological details, however, a more precise calculation is not possible.

26 In extractive activities, the progressivity criterion refers to the ability of the State to secure increased economic rent as the profitability of projects rises.

Figure I.16
Latin America and the Caribbean (selected countries): public revenue and economic rent from hydrocarbon extraction as a proportion of GDP, 2000–2021
(Percentages and index 2010=100)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and data from the World Bank.

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At the same time, public revenues from mining increased their shares of GDP (from 0.1% in 2000–2002 to 0.4% in 2019–2021) and of total revenue (from 0.3% to 1.5% over the same period). In the mineral sector, both prices and rent recorded positive trends during the study period, albeit at different rates. Revenue adjusted to the slower pace of prices, so that government revenues from this activity —already low compared to fossil fuel extraction— appeared to have fallen towards the end of the period. The degree of appropriation and progressivity was probably low, which can be explained by tax regimes that favour the generation of economic rents —by encouraging the activity, through higher investment in exploration and development that translate into lower production costs— but not their capture, with tax instruments that collect after production has started but are not sufficient to ensure progressivity.[27] Tax revenues earned through instruments of this kind, such as tax on corporate profits, accounted on average for about 60% of the revenue collected from the activity in the 2016–2018 period, compared to 49% in 2000–2002 (see table I.5 and figure I.17).

[27] In this regard, Gómez Sabaini, Jiménez and Morán (2015) point out that in contrast to hydrocarbon extraction activities, the region has not deployed instruments in the mining sector aimed at ensuring the progressive participation of the State in economic rent during periods of windfall profits.

Figure I.17
Latin America and the Caribbean (12 countries):[a] government revenue and economic rent from mineral extraction as a share of GDP, 2000–2021
(Percentages and index 2010=100)

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and data from the World Bank.

[a] The 12 countries selected to determine the region's weighted average public mineral revenues were Argentina, Brazil, Chile, Colombia, the Dominican Republic (since 2012), Ecuador (since 2006), Guatemala, Jamaica, Mexico, Nicaragua (since 2004), Peru and the Plurinational State of Bolivia. Mineral economic rents are expressed as the weighted average of the mineral rents of the 12 selected countries. The price indices are determined by using the base year 2010=100.

The foregoing highlights the impact of cyclical and volatile prices and, hence, of economic rent on public revenues and budgetary management in countries that are high dependent on natural resource exploitation and fiscally vulnerable to variations in it. These countries need not only to achieve good fiscal performance, but also to reduce the degree of dependence on public revenues derived from natural resource activities. This is possible through greater promotion of more sustainable investment and production in activities that exploit these resources, adequate appropriation of economic rent and more effective management in the use and distribution of public revenues derived from those activities, in order to create capacities for adding value, diversifying production and pursuing progressive structural change.

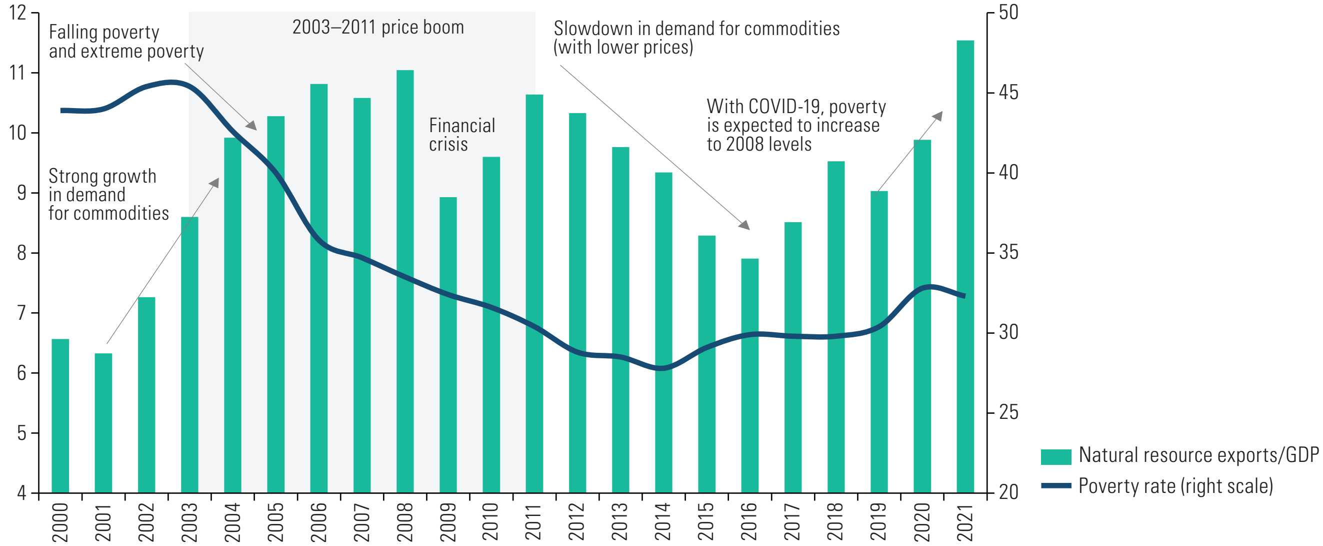
3. Social dimension

(a) Natural resources, poverty and employment

During much of the period analysed, the region reported significant economic dynamism, supported by the boom in commodity exports and prices, and this contributed to a sizeable reduction in poverty and income inequality (see figure I.18). Between 2000 and 2021, poverty fell from approximately 43.9% to 32.3% of the population, extreme poverty fell from 11.8% to 12.9%, and the Gini index improved from 0.53 in 2000 to 0.46 in 2021.[28]

[28] This analysis of poverty and inequality indicators examines 17 Latin American countries: the Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, the Plurinational State of Bolivia and Uruguay.

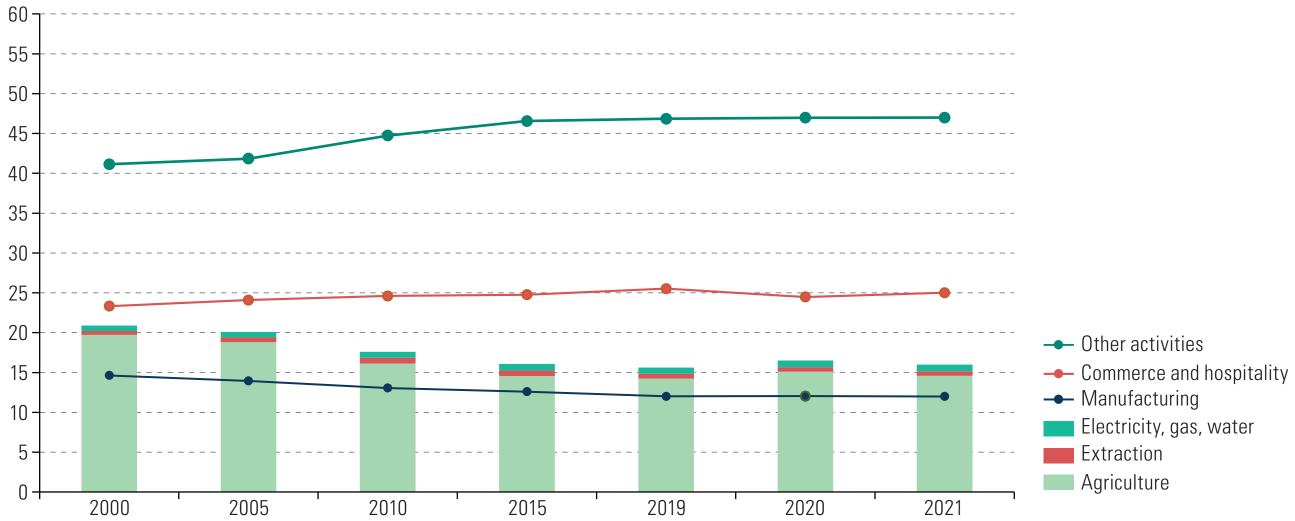
Figure I.18
Latin America: natural resource exports and poverty, 2000–2021
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of "Statistics and indicators: demographic and social", CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/dashboard.html?theme=1&lang=en and United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/.
Note: The population of Latin America living in poverty is measured as a percentage of the total population. Natural resource exports cover biomass, fossil fuels and minerals as a percentage of GDP.

Activities related to natural resources contributed 16.0% of the region's total employment. This share decreased between 2000 and 2021, mainly due to the evolution of employment in the agricultural sector. Agriculture contributed 14.6%, extractive industries 0.6% and electricity, gas and water 0.8%. Overall, these natural resource-related activities contributed more than manufacturing, but much less than commerce and hospitality, which accounted for, respectively, 12.0% and 25.0% in 2021 (see figure I.19).

Figure I.19
Latin America and the Caribbean (29 countries):[a] share of natural resource-related activities in employment, 2000, 2002, 2005, 2010, 2012, 2015, 2019 and 2021
(Percentages)

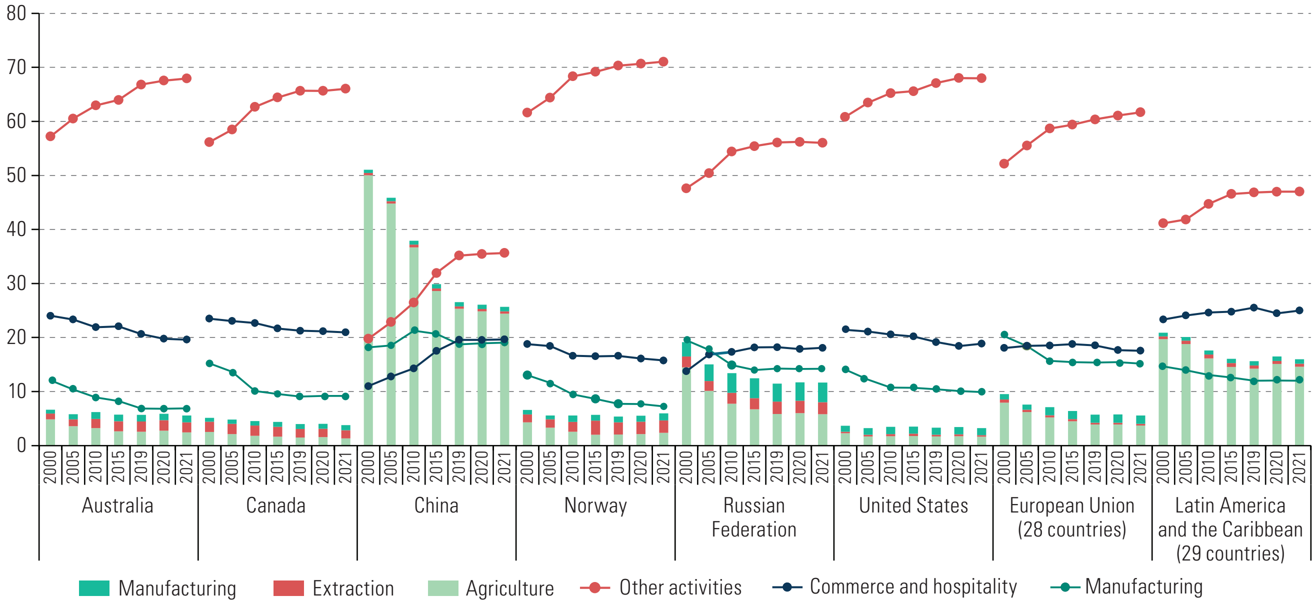


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and International Labour Organization (ILO), ILOSTAT [online] https://ilostat.ilo.org/.
[a] Does not include Antigua and Barbuda, Dominica, Grenada or Saint Kitts and Nevis as regards employment.

There is a wide range of variation among the region's different countries in terms of the share of natural resource-related activities in employment. For example, those activities accounted for 33.0% of total employment in Ecuador in 2021, with agriculture accounting for 32.2%. In the Bahamas, on the other hand, natural resource-related activities contributed only 4.7% of total employment.

The declining share of agriculture in total employment reflects a general trend across the world. In the region, however, agriculture still commands a much higher share than in other economies, with the exception of China. In contrast, economies with a high degree of dependence on non-renewable resources report a higher and growing relative contribution to total employment by the extractive sector compared to the region's numbers. The share of the electricity, gas and water industries is also small for those economies, but all of them, with the exception of China, exceed the region's result. The relative contribution increases more sharply in those that are highly dependent on natural resources (see figure I.20).

Figure I.20
Selected world economies:[a] share of natural resource-related activities in employment, 2000, 2002, 2005, 2010, 2012, 2015 and 2021
(Percentages)

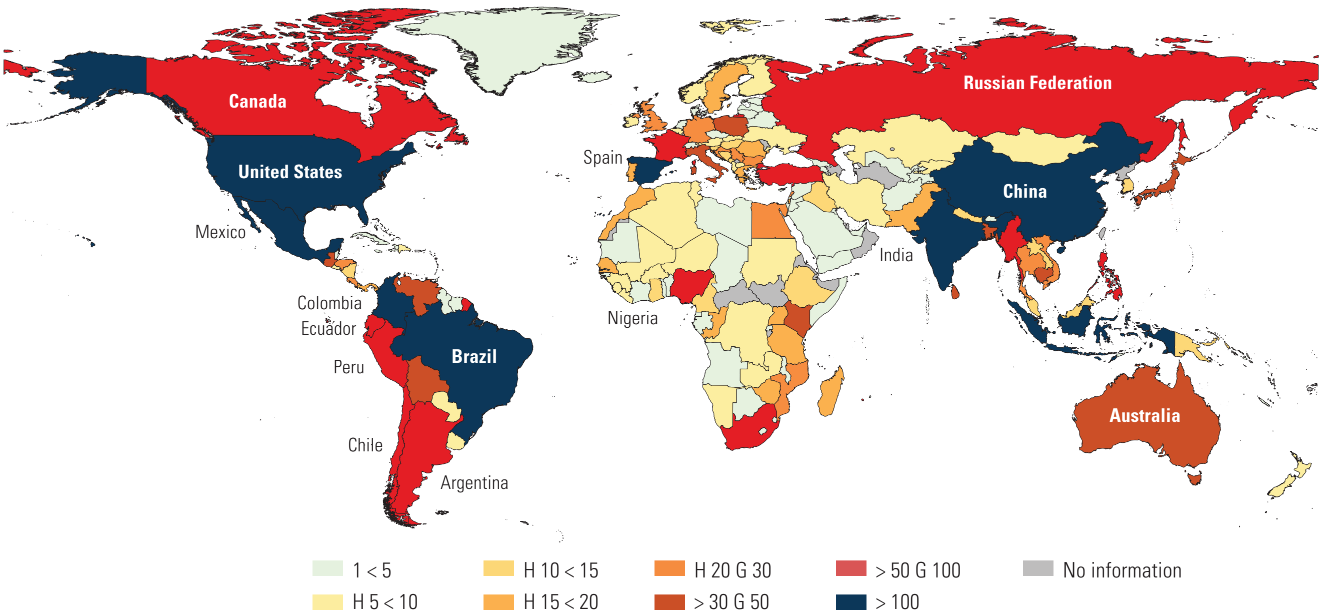


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Labour Organization (ILO), ILOSTAT [online] https://ilostat.ilo.org/.
[a] Does not include Antigua and Barbuda, Dominica, Grenada or St. Kitts and Nevis as regards employment.

(b) Socioenvironmental conflicts

Significant environmental challenges related to the unsustainable exploitation of natural resources still exist in the region, and they are a driver of social conflicts (Muradian, Walter and Martínez-Alier, 2012; Temper, Del Bene and Martínez-Alier, 2015; Temper and others, 2018). As a result, Latin America and the Caribbean is one of the regions with the most socioenvironmental conflicts relating to mineral and metal extraction, biomass and land use, fossil fuels, water management and biodiversity (see map I.2). Environmental conflicts can be defined as social conflicts related to the environment that are driven by different economic activities linked to the production chain and the extraction frontier: exploitation of resources, production, consumption and waste management (Scheidel and others, 2020). They may also be associated with unfair distribution or unequal access to natural resources such as water, air quality, access to fertile land or exposure to air pollution, risks and threats to health, livelihoods, and social and cultural identities (Martínez-Alier and O'Connor, 1996). Up to a certain threshold, environmental conflicts tend to increase as natural resources become scarcer or are depleted, degraded, or overused (Martínez-Alier and others, 2016). In particular, communities living near natural resource exploitation sites organize and react to a series of negative externalities that those activities have on their quality of life and on their access to other resources and services such as water rights, energy, transport, and health and education services.

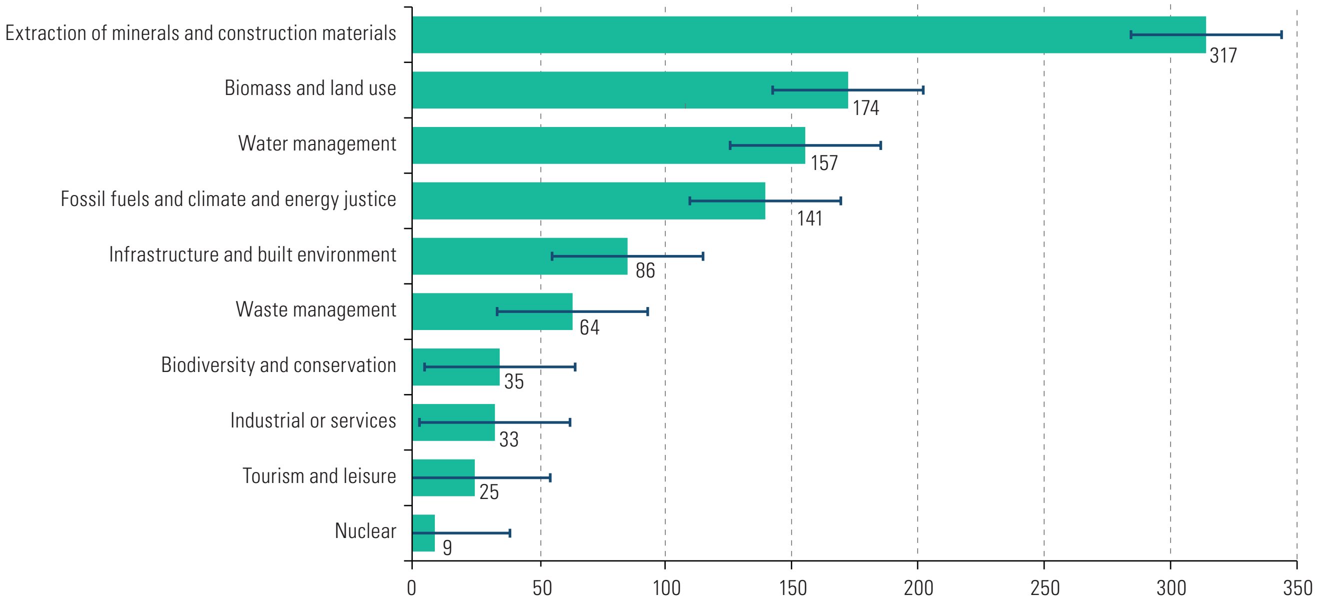
Map I.2
Environmental conflicts by category recorded in the Environmental Justice Atlas (EJAtlas)
(Number of conflicts)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Environmental Justice Atlas (EJAtlas) [online] https://ejatlas.org, L. Temper, D. del Bene and J. Martinez-Alier, "Mapping the frontiers and front lines of global environmental justice: the EJAtlas", *Journal of Political Ecology*, No. 22, 2015.
Note: Data as of 14 February 2022.

Figure I.21, based on the Environmental Justice Atlas, shows the percentage breakdown by category of environmental conflicts related to natural resources in Latin America and the Caribbean, a region that accounts for almost one third (28%) of the total number of conflicts worldwide. Mining production processes and the extraction of construction materials generate 30.5% of the total number of conflicts in the region, followed by biomass and land use, with 16.7%. These are followed by conflicts relating to water management, 15.1%, fossil fuels and climate justice, 13.5%, infrastructure, 8.3%, waste management, 6.1%, and biodiversity conservation, 3.4%, while industry and services account for 3.2%, tourism for 2.4% and nuclear power plants for 0.9%. In particular, it should be noted that conflicts related to mining activities account for a significant portion of the conflicts in the region's countries due to water, air and soil pollution caused by the extraction, smelting and transportation processes, competition for water use, the destruction of habitats and protected areas, the overlapping of mining concessions with areas with high levels of biodiversity, environmental liabilities and high-risk informal and illegal activities (International Resource Panel, 2020).

Figure I.21
Latin America and the Caribbean: environmental conflicts by category recorded in the Environmental Justice Atlas
(Number of conflicts)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of data from the Environmental Justice Atlas (EJAtlas) [online] https://ejatlas.org, L. Temper, D. del Bene and J. Martinez-Alier, "Mapping the frontiers and front lines of global environmental justice: the EJAtlas", *Journal of Political Ecology*, No. 22, 2015.

Note: Mining accounts for 30.5% of the total number of conflicts (n = 317), biomass and land use for 16.7% (n = 174), water management for 15.1% (n = 157), fossil fuels for 13.5% (n = 141), infrastructure for 8.3% (86 cases), waste management for 6.1% (n = 64), biodiversity conservation for 3.4% (n = 35), industry for 3.2% (n = 33), tourism for 2.4% (n = 25) and nuclear energy for 0.9% (n = 9). Data as of 14 February 2022.

C. Towards a comprehensive natural resource-based strategy for sustainable development

The countries in the region that have extensive endowments of natural resources can formulate and implement a comprehensive strategy for sustainable development based on natural resources that addresses the problems identified in the previous section. The following general guidelines could serve as a basis for such a strategy.

1. Natural resources and sustainable development

The relationship between natural resources and sustainable development must take account of the different dimensions of sustainability: in other words, its economic, social, environmental and institutional dimensions. In the economic dimension, natural resources play a key role in generating employment, foreign exchange and economic rent. In the real sector of the economy, on the one hand, extractive natural resources and renewable energy receive significant volumes of foreign direct investment and, on the other hand, productive activities associated with renewable natural resources —especially agriculture and the construction of infrastructure for basic water and energy services— create substantial numbers of jobs. In the external sector, natural resources from extraction and agriculture generate foreign exchange and a trade surplus to finance the manufacturing trade deficit. In fiscal terms, extractive natural resources are important generators of economic rent, the capture of which by governments generates tax revenues and the financing of sovereign wealth funds, both of which are necessary to expand public spending and manage economic and price cycles. Finally, as regards the monetary and financial sector, effective management of the volatility of natural resource prices and rent is essential in order to cushion the effects of commodity price booms and busts on the exchange rate and of foreign exchange flows on domestic credit.

Natural resources can also play an essential role in reorienting the productive structure towards economic activities that are more innovative, efficient and sustainable. This can be achieved both through a process of natural resource-based industrialization and by directing the tax revenues and foreign exchange flows generated by the primary sectors towards productive diversification and more knowledge- and technology-intensive sectors. A positive vision of natural resources is needed, in order to escape the dependence on extractive industries in which several countries have become mired.

Within the social dimension, natural resources —including the basic services and ecosystem services associated with them— contribute to the reduction of poverty and inequality. This requires greater equity in access to natural resources and to basic services based on them. For example, universal access to drinking water and electricity must be guaranteed, and inequality in access to and ownership of land must be reduced.

In the environmental dimension, consideration must be given to the biophysical exchange with nature required for the reproduction and growth of the socioeconomic system. It is therefore important that the well-being of present and future generations be taken into account. In pursuit of that goal, progress must be made towards greater efficiency in the use of materials and energy and in decoupling, in both relative and absolute terms, economic growth from the use of natural resources and the emission of greenhouse gases. The development of the bioeconomy and the circular economy is of relevance in that regard. At the same time, the ecosystem services provided by nature and the critical natural heritage must be protected.

Finally, the institutional dimension is of paramount importance. Within it, progress must be made towards renovating the governance of natural resources. Although the concept of governance has multiple meanings, in this document it is understood as the process whereby the ownership, appropriation and distribution of the costs and benefits of renewable and non-renewable natural resources are governed so that society as a whole can benefit from their exploitation or conservation.

2. New governance of natural resources for a more sustainable development model

A new form of governance for the region's natural resources could contribute to them becoming a pathway to progressive structural change, socioecological transition and a more sustainable development model. This requires a type of governance with certain characteristics: it has to be multilevel, transparent, democratic and effective, and it must incorporate the life-cycle approach to natural resources and the territorial approach.

The new natural resource governance model requires a multilevel perspective: in other words, one that encompasses the different levels of government (local, national, regional and international). Internationally, many natural resources are subject to changes in geopolitics and global trends (e.g. in the expansion of reserves and production), commodity price volatility, dependence on world demand and terms of trade, dependence on financing and technology (e.g. foreign direct investment) and how they are inserted into global value chains. At the regional level, for example, there is little coordination and integration among the different countries to add value in mining or to secure greater market power (in lithium and copper, for instance). In addition, the construction of regional value chains within the framework of integration processes has been weak. Nationally, different countries have different positions regarding the importance of national sovereignty over natural resources. Similarly, nation States are, in general, the owners of the extractable natural resources found in their subsoil, and this represents a structural source of conflict with local governments and the communities situated where the resources are located, who, in turn, suffer the social and environmental impacts of exploitation. This gives rise to a series of distributive and environmental conflicts related to areas such as taxation of revenues, environmental regulation and community benefits. Natural resource governance must therefore deal with conflicts between various actors at different levels, including national and local governments, transnational and national companies, civil society organizations and communities.

At the same time, the new governance requires greater transparency throughout natural resource value chains: for example, in exploitation contracts, the distribution of economic rent, taxation and the investment of revenues. It must also be democratic, which requires ensuring equal access to information and genuine multi-stakeholder and multisector social participation (e.g. ensuring adequate processes of free, prior and informed consultation with indigenous communities). This is an area where greater social and institutional innovation in participation and coordination mechanisms could be encouraged. However, governance must also be effective: it must ensure that stakeholders with various competing interests arrive at decisions that can resolve collective problems in order to facilitate progress towards a more sustainable development model. Finally, the new governance must incorporate both the life-cycle approach to natural resources and the territorial approach. The life-cycle approach is necessary for the integrated management of natural resources, from their exploration, by way of their exploitation, distribution and use of the economic rent generated, to —in the case of extractive resources, for example— the closure and post-closure of mines, the possibility of recycling or circular economy initiatives. Similarly, the territorial approach is important since the exploitation or conservation of natural resources takes place in specific places, surrounded by human populations and ecosystems. Thus, for example, it would be incorrect to speak only of the governance of lithium in the salt flats: the topic must be the governance of the salt flats themselves, since they are territories that include different types of natural resources in tension, such as water and lithium, or different economic activities, such as tourism and mining.

3. Effective management of natural resources

Along with a new model of governance, the effective management of natural resources at both the microeconomic and macroeconomic levels is required. As regards the latter, economic rent from non-renewable natural resources must contribute to a stable macroeconomy geared towards sustainable development. This requires ensuring that volatile commodity prices do not affect macroeconomic stability and growth, avoiding exchange rate appreciations and outbreaks of the Dutch disease during price booms, increasing the stability of tax revenues, correctly managing windfall economic rent from natural resources and increasing tax progressivity, increasing public revenues from natural resources without affecting the investment climate, and ensuring effective and transparent investment of rent from natural resources towards the achievement of the Sustainable Development Goals (SDGs). At the microeconomic level, all projects that involve the use or conservation of natural resources must be managed in an effective and sustainable manner, so as to guarantee, over time, their economic and social usufruct and their environmental sustainability. For example, a mining project must include local labour and procurement, be transparent in contractual reporting and accounting for the revenues it generates, share collective infrastructure with the community, use water and energy sustainably and schedule mine closure and post-closure well in advance. In addition, companies that produce or extract natural resources must be committed to implementing global strategies in the territories and avoiding new systemic crises from the launch of their projects.

4. Progressive structural change, eradicating poverty and expanding equity

The structural duality of the region's economies poses a challenge for the formulation of public policies for natural resources. On the one hand, the modern sector is moving towards the international technological frontier.[29] On the other, a vast productive segment remains tied to production organization models dominated by smallholdings, low productivity, labour informality and scant opportunities for progress. For this reason, a comprehensive strategy for sustainable development based on natural resources must include the possibility of progressive structural change as well as the eradication of poverty and the expansion of equality. According to Pérez (2010), the strategy, in the productive sphere, could involve two major components. The first is a proposal for industrialization based on natural resources (top-down growth) that includes the following guidelines: (i) increasing technological capacities in biotechnology and materials science in export-oriented natural resource-based industries, (ii) transferring Ricardian rents and quasi-rents from natural resources to technological or innovation quasi-rents, and (iii) reaching the technological frontier and securing a better insertion in the technological revolution towards biotechnology, nanotechnology, bioelectronics, new materials, renewable energies and electromobility. At the same time, the strategy must be complemented by a proposal for a natural resource-based economy that can create local employment, reduce poverty and expand equality (bottom-up growth). This component could be directed by the following guidelines: (i) wealth creation through productive clusters throughout the territory to improve the quality of life based on local advantages, (ii) the promotion of productive investment programmes, with external support and based on local resources and capacities, (iii) targeting local, regional or global market niches, as the case may be, and (iv) closing the technological and productivity gaps between companies and between sectors, so as to reduce the structural heterogeneity of the region's economies (see box I.1).

29 The modern sector is currently facing "disruptive" technological transformations of a Schumpeterian nature as a result of changes at the frontier of knowledge in fields such as biotechnology, genomics, digital services, artificial intelligence and big data, as well as new ways of organizing production and changes in business models.

Box I.1
Impact of trade and investment agreements on natural resource-related policies

The trade and investment agreements signed by the region's countries can have an impact on the policy space available to them for the exploitation and use of their natural resources and they can also place various types of conditions on them.[a] This is particularly the case in agreements negotiated with developed partners, known as "North-South" agreements, which tend to limit that policy space to a greater extent than agreements between developing countries, or "South-South" agreements. This is partly explained by the significant presence of multinational companies headquartered in developed countries but with operations bases in the region for the exploitation of natural resources.

In general, the provisions governing liberalization and the protection of foreign investment contained in investment and free trade agreements have a greater potential impact on natural resource policies than the actual trade provisions.

First, both types of agreements usually provide foreign investors with a broad range of assurances, such as so-called fair and equitable treatment and protection against indirect expropriation. In addition, foreign investors have the right to sue the host State in ad hoc tribunals, often within the framework of the World Bank's International Centre for Settlement of Investment Disputes (ICSID).

One recent example of how trade agreements can have an impact on domestic natural resource policies is the dispute filed in July 2022 by the United States against Mexico under the Agreement between the United States, Mexico, and Canada (USMCA), the successor to the North American Free Trade Agreement (NAFTA). In that ongoing dispute, the United States is challenging various aspects of Mexican energy legislation that, in its opinion, favour Mexican State-owned companies over companies from the United States.

In many cases, the region's countries have been able to exclude certain policy measures from the scope of their trade and investment agreements. For example, in the recent update of their agreement, the European Union accepted Chile's right to reserve a part of its national lithium production to be sold at a preferential price to companies that have committed to add value to the resource locally.

At the same time, trade agreements can promote good practices with respect to the exploitation, conservation and sale of natural resources in their signatory countries. For example, the environmental chapter of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), of which Chile, Mexico and Peru are members, contains provisions aimed at protecting biodiversity and combating overfishing (see Office of the Undersecretary for International Economic Relations, n.d.). The European Union's updated agreements with Chile and Mexico include chapters on trade and sustainable development, which contain commitments on sustainable forest management (including efforts to combat illegal logging), biodiversity protection, sustainable fisheries management and other similar issues (see European Commission, 2018 and 2022). At the multilateral level, the Agreement on Fisheries Subsidies, concluded in June 2022 under the aegis of the World Trade Organization (WTO), prohibits fisheries subsidies linked to overfished stocks, as well as those that contribute to illegal, unreported and unregulated fishing, in accordance with target 14.6 of the Sustainable Development Goals (SDGs) (see WTO, n.d.).[b]

In light of the considerations set out above, it is recommended that in negotiating trade and investment agreements, and particularly with developed partners, the region's countries seek to preserve an adequate policy space with respect to the exploitation and use of strategic natural resources, so those agreements can serve to promote industrialization and employment in their economies. Those spaces should be defined by means of a process involving all the relevant ministries and public agencies and in consultation with relevant stakeholders from both the private sector and civil society.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations Conference on Trade and Development (UNCTAD), *Trade and Development Report, 2014: Global Governance and Policy Space for Development*, New York, 2014; Office of the Undersecretary for International Economic Relations, "Capítulo 20: medio ambiente", Tratado Integral y Progresista de Asociación Transpacífico [online] https://www.subrei.gob.cl/docs/default-source/tratado-tpp11/20–medio-ambiente.pdf?sfvrsn=a70a7789_2; European Commission, "EU-Chile Advanced Framework Agreement", 2022 [online] https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/chile/eu-chile-agreement/text-agreement_en; European Commission, "EU-Mexico agreement: the agreement in principle", 2018 [online] https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/mexico/eu-mexico-agreement/agreement-principle_es; and World Trade Organization (WTO), "The WTO Agreement on Fisheries Subsidies" [online] https://www.wto.org/english/tratop_e/rulesneg_e/fish_e/fish_factsheet_e.pdf.

[a] The concept of "policy space" has been defined by the United Nations Conference on Trade and Development (UNCTAD, 2014) as the freedom and ability of governments to identify and pursue the most appropriate mix of economic and social policies to achieve equitable and sustainable development in their own national contexts.

[b] See [online] https://www.wto.org/spanish/tratop_s/rulesneg_s/fish_s/fish_factsheet_s.pdf.

5. Socioecological and sectoral transitions

From an environmental perspective, natural resources can help give sustainability a major boost. This requires a coordinated, coherent and interconnected policy effort aimed at a just socioecological transition. This, in turn, comprises a series of sectoral transitions: agroecological, water, mining, energy and biodiversity management, as explained in the sector-specific chapters. The socioecological transition must seek to achieve greater environmental efficiency, the reduction of ecological, carbon, material and water footprints, the preservation of critical natural heritage, and the transition from a linear social metabolism to a more circular one that minimizes entropy and decouples the use of natural resources from economic growth. The socioecological transition must therefore be an explicit part of a comprehensive natural resource-based sustainable development strategy.

6. Role of natural resources in the COVID-19 pandemic and post-pandemic recovery

Natural resources are also relevant in the context of the COVID-19 pandemic and the post-pandemic recovery. In particular, in the short term, basic water and energy services are essential for dealing with the pandemic; investment in those services and in agriculture can help create employment and reactivate the economy, and tax revenues and sovereign wealth funds financed by economic rents from non-renewable natural resources can be used to meet emergency and investment needs. In the medium and long terms, economic rents from natural resources must be transparently and effectively invested in order to contribute to the SDGs, to changing the energy matrix and to a greater relative and absolute decoupling of natural resources from economic growth.

7. Political economy of natural resources for sustainability

Structural constraints, such as restrictions imposed by the balance of payments, external technological gaps and others, condition countries' destinies but do not determine them. Neither the tragedy of the commons nor the "resource curse" are inexorable fates: with appropriate governance, institutional frameworks and policy measures, they can be avoided. Moreover, the low-growth trap, the culture of privilege, rentierism and extractivism can be overcome with institutional, policy and cultural changes that promote, *inter alia*, progressive structural change with equality and sustainability. Accordingly, the capacity of the political system to generate legal, institutional and policy frameworks favourable to transformation processes plays a particularly essential role.

In order to change the current situation of dependence on natural resources and the unsustainability of their management, attention must be paid to their political economy. Coalitions of stakeholders (technical, bureaucratic, social, academic, business or political actors) must be formed to promote institutional, cultural and policy changes conducive to progressive structural change, egalitarian institutions, a culture of equality and a socioecological transition. These stakeholder coalitions have a historical and political role to play in providing a big push for sustainability, understood as a coordinated, integrated and coherent set of policies (industrial, technological, fiscal, social, environmental, natural resources and employment), to which institutional and cultural changes must be added.

The role of ECLAC is to influence the stakeholders in order to promote the political will for transformation. The context of COVID-19 and the social emergency can catalyse political will to bring about the desired change: more efficient (in economic and environmental terms) use of natural resources, better distribution of the costs and benefits of their exploitation and progress away from dependence on extractive industries.

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CHAPTER

II

Towards a just and sustainable energy transition in Latin America and the Caribbean

Introduction

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Introduction

In recent decades, sustainable development has come to include universal access to energy, which must, by definition, be generated and used sustainably and efficiently. Quality access to energy services has a profound impact on health, water access, productivity, extractive industries, transport, education, food security, communications and climate change. Hence, the use of renewable, clean and modern energy sources is a fundamental requirement for improving living standards, reducing poverty and energy poverty, promoting economic growth, creating employment opportunities, facilitating the provision of social services, improving levels of schooling among the most disadvantaged segments of the population, and generally furthering sustainable human development.

At the halfway point on the path towards the targets of Sustainable Development Goal (SDG) 7, the region's situation is complex: some progress has been made, but many challenges remain.[1] To resolve them, it is recommended that countries start implementing the ECLAC proposal for the energy transition, along with its pillars for simultaneous acceleration and guidelines on central and interconnected public policies. The region's failure to meet all the targets of SDG 7 would jeopardize the engine of sustainable development and the fulfilment of the other SDGs.

This chapter offers an in-depth analysis of the situation of energy resources in Latin America and the Caribbean and details the energy transition proposed by ECLAC in light of the region's challenges and opportunities. It also sets out public policy guidelines that serve as concrete suggestions for making the transition a reality and accelerating its development, based on the need to strengthen energy governance and regulatory frameworks in order to create a new transition ecosystem in each country. The energy transition is an engine for the transformative recovery of the region's development models, based on the productive development of new value chains in the energy sector and related industries. The transition will create and preserve jobs and produce surpluses through innovation and the sustainable use of human capital and natural resources (understood as both renewable resources and the region's stock of critical minerals).

A. Situation of energy resources and services in Latin America and the Caribbean

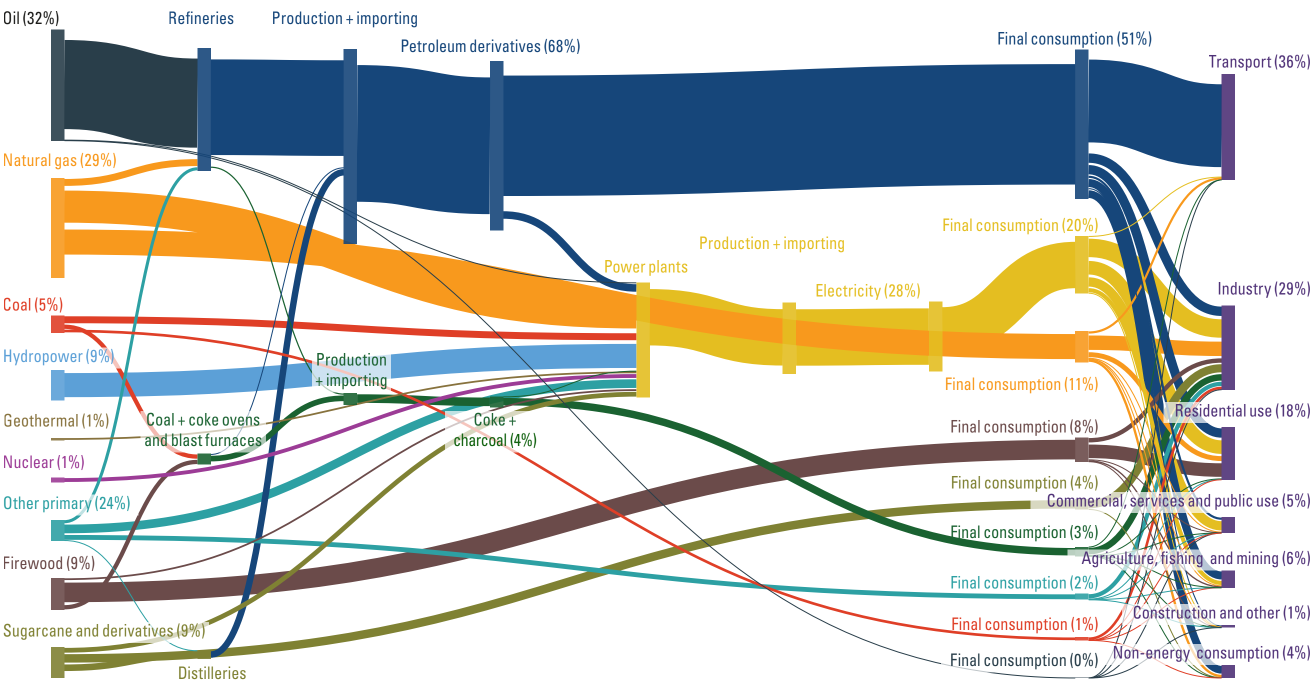
1. The Latin American and Caribbean energy mix

The energy flow in Latin America and the Caribbean shows the share of the different sources of energy generated in the region as a whole, the availability of that energy —the primary supply— and its various transformations, such as the generation of electricity, up to final use (consumption) in each sector (see diagram II.1). In 2021, fossil fuels continued to dominate the primary energy supply, accounting for 66.8% of the total, with renewable sources contributing 33.2%. In 2020, global greenhouse gas (GHG) emissions totalled 49.4 billion tons of carbon dioxide equivalent (CO_2e), and across the different sectors of the economy, energy was responsible for 73% of that total. Latin America and the Caribbean emit 10% of global GHG emissions, but energy accounts for a smaller proportion of the region's total (estimated at 55%), as most of its emissions come from land-use change, deforestation and agricultural practices.

[1] ECLAC (2023b) contains a review of the progress made towards SDG 7 in the countries of Latin America and the Caribbean halfway to 2030.

As shown in diagram II.1, primary energy is transformed and then used in different sectors of the economy, households and institutions. The main final energy consumers are transport (36%), which almost exclusively uses fossil fuels, industry (29%), and the residential sector (18%); together, the three account for more than 83% of total consumption. Energy efficiency and the progressive decarbonization of these three sectors —transport and industry in particular, which mostly or exclusively use fossil fuels— is crucial to progress towards the energy transition proposed by ECLAC for the region's countries.

Diagram II.1
Latin America and the Caribbean: overview of the energy mix, 2021
(Percentages)



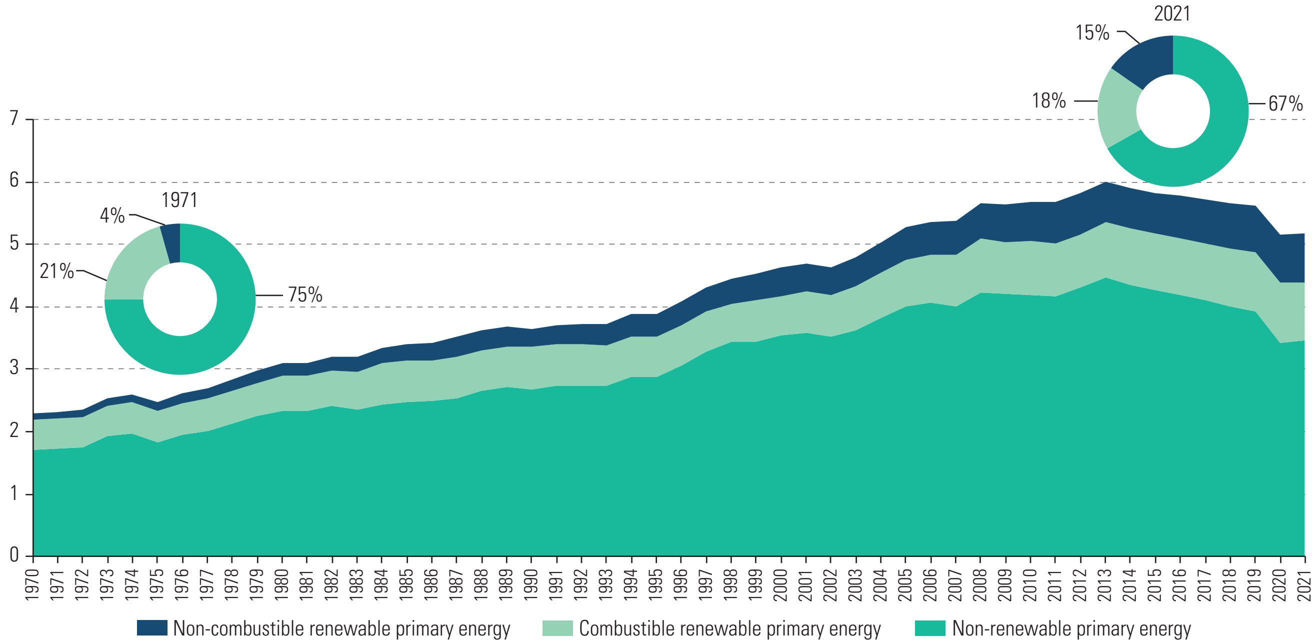
Source: Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

Between 1970 and 2021, the primary energy supply in Latin America and the Caribbean expanded from 2.28 billion barrels of oil equivalent to 5.183 billion (a 2.3-fold increase) to meet the needs of the region's economy and growing population. The share of renewable energy grew even faster, both in absolute terms and as a proportion of the total: it accounted for 25% in 1971 and for 33% in 2021, with the caveat that the latter figure should be seen in light of the region's decreased economic activity and curtailed energy supply resulting from the pandemic (see figure II.1).[2]

In 2021, renewables that require combustion (such as firewood and bagasse), and therefore generate emissions, accounted for 18% of the region's total energy supply, and non-combustible renewables (such as hydro, solar, wind and geothermal power) contributed 15% (see figure II.2).

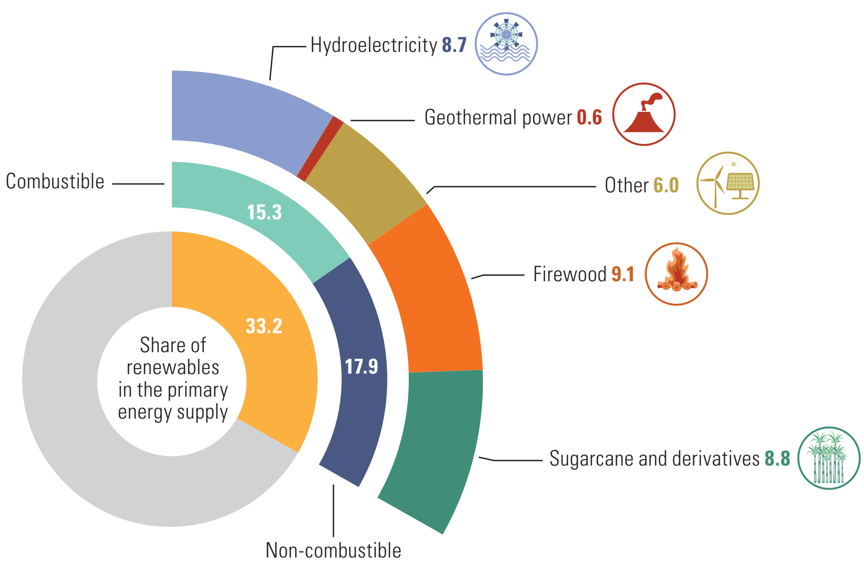
2 Because of the lockdowns imposed, the demand for electricity and fossil fuels from transport, commerce and industry fell sharply. ECLAC estimates that during the pandemic, in 2020 and 2021, electricity demand fell by between 15% and 25% in the region's countries.

Figure II.1
Latin America and the Caribbean: renewable content of the primary energy supply, 1970–2021
(Billions of barrels of oil equivalent)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

Figure II.2
Latin America and the Caribbean: renewable primary energy supply, by type, 2021
(Percentages)



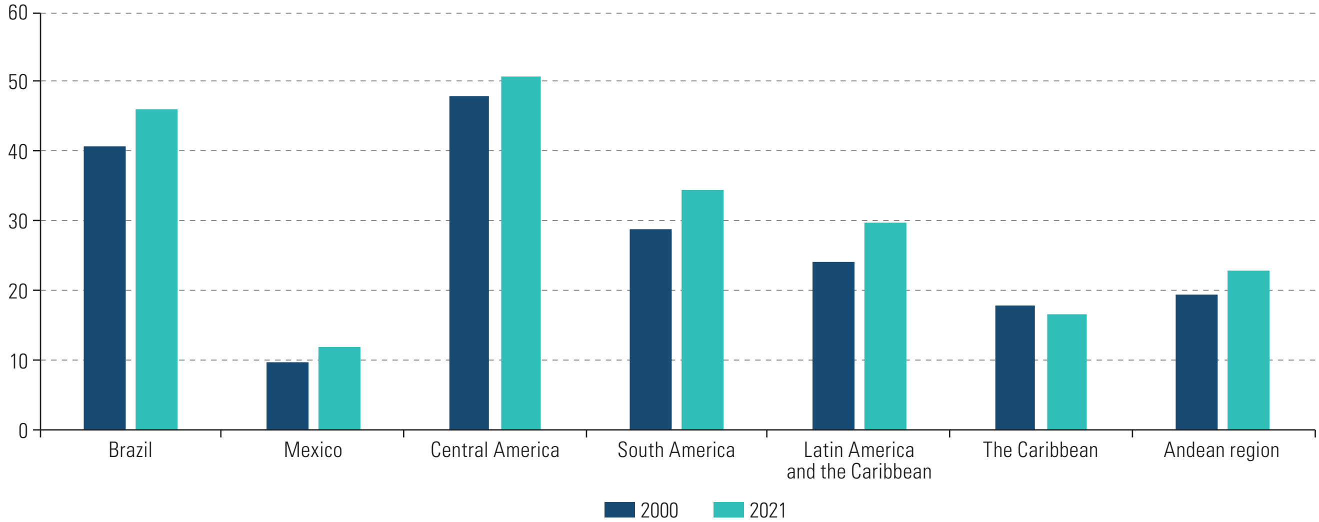
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

Latin American and Caribbean countries have been adopting renewable energies, primarily hydroelectricity, since before the 1970s, and major opportunities exist for the further incorporation of new technologies, such as solar and wind power, into their energy mixes (ECLAC/UNASUR, 2013; Altomonte, 2017). This is mainly on account of the abundant natural resources available in the region: water, solar and wind in particular, but also geothermal power and, more recently, materials essential for energy storage and green hydrogen.

Recent times have seen more rapid adoption of solar and wind energy in the electricity generation sector. Even so, as shown in figure II.2, hydropower and biomass (especially firewood and charcoal) still account for a large share of the region's renewable primary energy supply.

The evolution of the renewability index of the primary supply calculated by the Latin American Energy Organization (OLADE) shows the changes recorded in the region's countries at different times (see figure II.3). Five-year moving average rates indicate that the values of this index rose between 2000 and 2010, were negative between 2010 and 2021, and were slightly positive in 2021. However, the actual pace of regional progress towards low-emission energy systems is well below the accelerated transition set out in the 2015 Paris Agreement.[3] Globally, energy demand trends in recent years have triggered another alarm, warning the world that it is on an unsustainable path of fossil fuel-based energy consumption with low or declining levels of efficiency.

Figure II.3
Latin America and the Caribbean: energy renewability index, 2000 and 2021



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.
Note: The OLADE renewability index indicates the share of renewable primary energy within the total energy supply.

At the subregional level, as shown in figure II.3, the Caribbean, the Andean region and Mexico have lower renewability indices than the other subregions. Examining the trends reveals that over the last 20 years, the renewability of the Caribbean's primary energy supply has decreased slightly, while it has increased in Central America, Brazil, Mexico, the Andean region and South America. At the same time, among fossil sources, oil was clearly being replaced by natural gas over the same period (2000–2021): thus, the share of oil fell from 50% to 32%, while that of natural gas rose from 19% to 29%.

Diagram II.2 provides an overview of the energy products used to generate the total primary energy supply in different groups of the region's countries, with Mexico and Brazil shown separately. Hydropower is dominant among renewable energies in the Andean region, South America and Brazil, although the percentages do not exceed 14%. In turn, Central America reports high rates of firewood use (47%).

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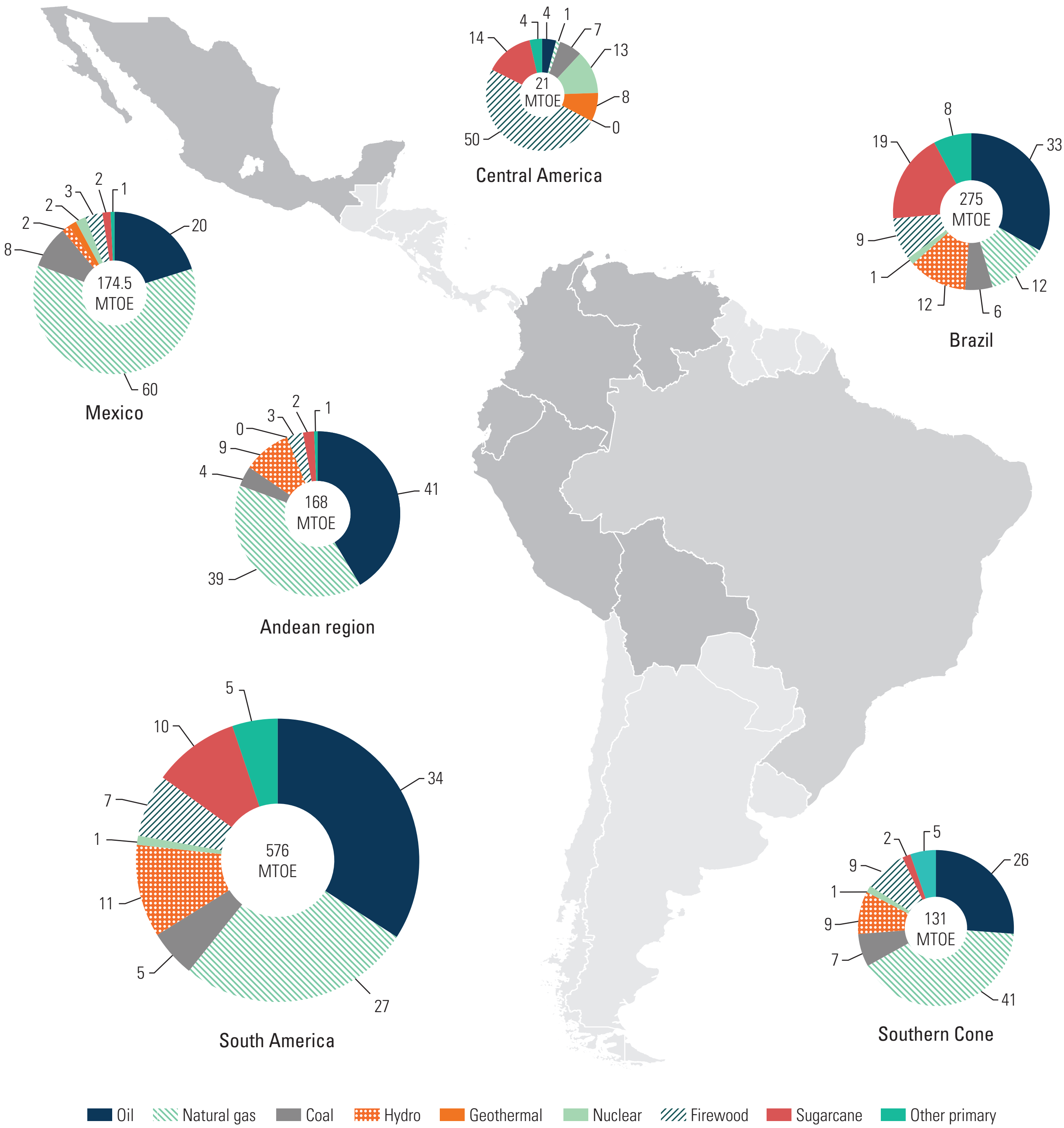
3 The Paris Agreement was adopted at the twenty-first session of the Conference of the Parties to the United Nations Framework Convention on Climate Change.

Diagram II.2
Latin America: breakdown of the total primary energy supply, 2021
(MTOE[a] and percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

[a] MTOE means million tons of oil equivalent.

2. The electricity sector: renewability, investments and regulatory challenges

(a) Renewables in electricity generation

The electricity sector, in which renewable sources account for a rising share, offers great potential for decarbonizing countries' energy mixes to the extent that transport, industry, heating, cooking and other uses can be electrified.[4]

In 2021, an average of 59% of the electricity generated in the region was renewable, twice the global rate. The share of renewable sources in electricity generation varies widely from one country to another: in some it is less than 5%, while in others can reach 100%. Fossil fuels still account for a large share in most, but renewable sources are on the rise. Both electricity supply and demand are expected to continue to grow in Latin America and the Caribbean, and the renewable portion is expected to expand significantly; this is in line with projections of global net-zero scenarios, in which electricity is emerging as the world's largest source of energy, with demand expected to double between 2021 and 2050 (IEA, 2023).

At the same time, distributed electricity generation systems supplied by renewable sources can increase coverage and accelerate the transition towards modern electricity services in the various territories of the region's countries.[5] The falling costs of photovoltaic solar technology and its storage devices (lithium batteries) make this technology the most economical alternative for the electrification of remote or isolated rural areas (for example, off-grid systems or microgrids). This is essential given that there are still 16.1 million people in the region without access to electricity and 77 million who cook with firewood and other polluting sources of energy. Moreover, some vulnerable households that are connected the electricity grid receive poor quality, intermittent service.

In 2020, renewable electricity generation across the region produced a total of 952 terawatt hours (TWh), with an installed capacity of 274 gigawatts (GW). New renewable energy installations generated 11 GW: 53% used solar energy and 31% used wind (OLADE, 2021). In 2021, renewable energy generation projects, using wind and solar power in particular, continued to expand: 23.5 GW of new generation capacity was installed, with renewable energy accounting for 81% of that amount. Of that total, non-renewable thermal power plants accounted for 4.5 GW, wind power plants for 5.9 GW, photovoltaic solar plants for 9.8 GW, and hydroelectric plants for 2.4 GW, with the rest coming from renewable thermal plants (biogas and biomass) (OLADE, 2022).

Hydroelectric generation continues to be the most profitable and cost-effective supply option in the region. Hydropower still costs less than wind and photovoltaic solar power, although the gap is closing and all power from renewable sources is now cheaper than energy from fossil fuels. The diversification of the energy mix and the increased use of renewable energies are among the key factors for improving the resilience of the energy and electricity system.

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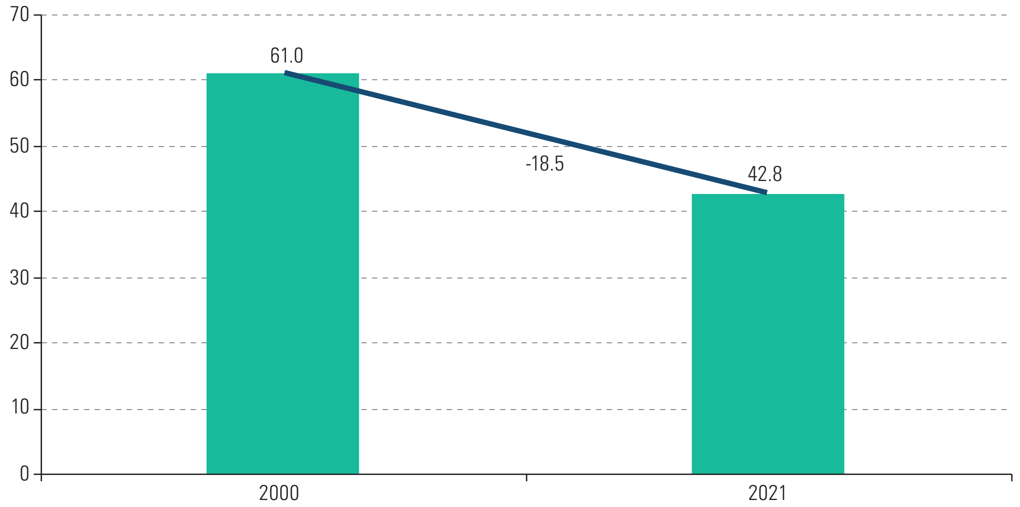
4 Latin America and the Caribbean contribute 10% of global GHG emissions. Countries are committed to reductions through their nationally determined contributions (NDCs), but these are being implemented more slowly than expected (UNEP, 2022). The region would have to increase its investment efforts eight-fold to meet the mitigation needs committed to in its NDCs and thus meet the 1.5°C target (UNEP, 2022).

5 Distributed generation is an approach in which small-scale technologies are used to produce electricity in proximity to end consumers. These generation technologies are based on renewable energies and digitization.

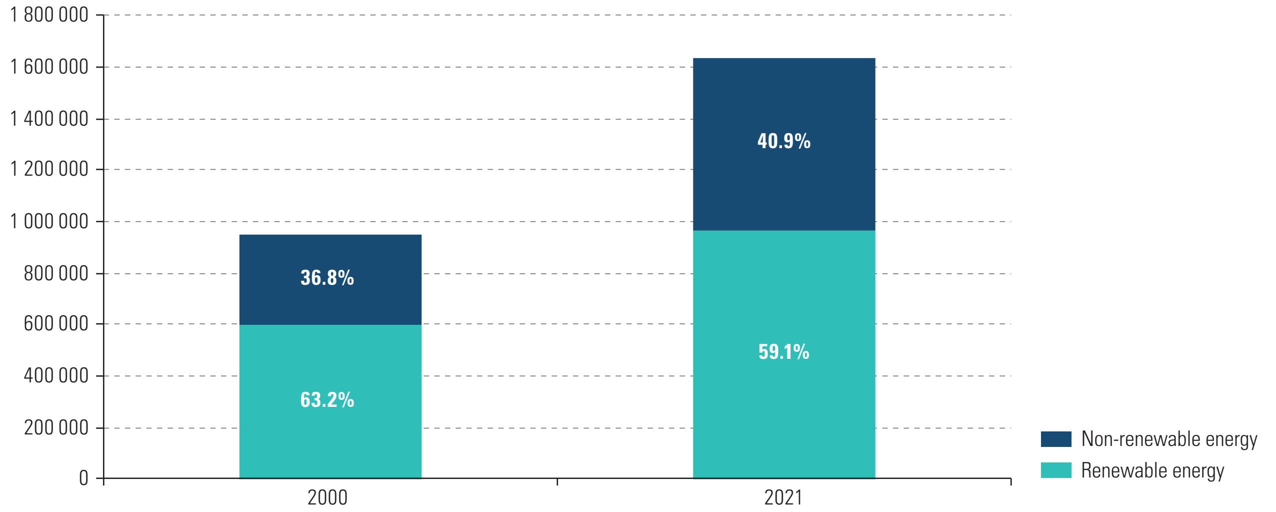
Figure II.4
Latin America and the Caribbean: share of hydropower in electricity generation, 2000 and 2021
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

Renewable generation capacity has increased, but not enough to offset the drop in the share of hydropower over the last two decades (see figure II.4). Instead, in a context of cascading crises, part of that shortfall was made up by power generated using fossil fuels, which increased by more than 4% between 2000 and 2021 (see figure II.5).

Figure II.5
Latin America and the Caribbean: share of renewable and non-renewable electricity generation sources, 2000 and 2021
(GWh)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

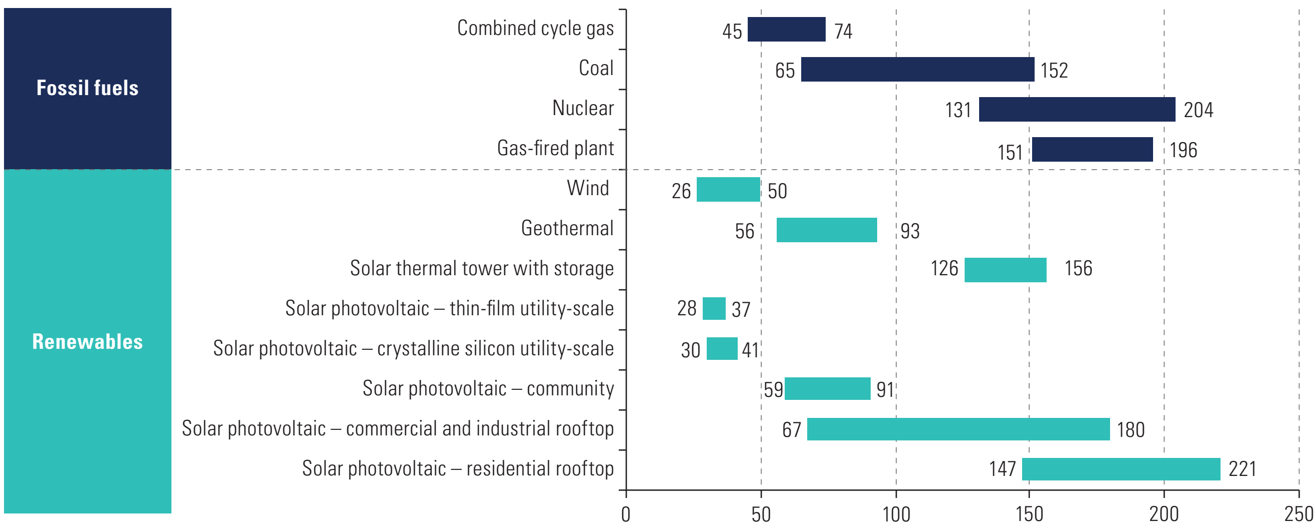
Notably, in the Central American subregion, and in particular in the eight countries of the Central American Integration System (SICA), the renewability index is trending upward. Thus, renewable sources contributed 60.4% of electricity output in 2021, a record for the subregion.

(b) Levelized cost of electricity generation: fully competitive renewable energies

Significantly cheaper renewable energy is boosting the competitiveness of renewables in the current context of rising global hydrocarbon prices.

Over the past decade, the cost of wind power has more than halved worldwide, while the cost of solar photovoltaic power and batteries has fallen by 85% (Guterres, 2022). These values depend on production volumes, the technology used and the start-up date, which are all included in the levelized cost of energy (LCOE). According to global estimates from 2021, the cost of generating renewable electricity at scale using wind and solar photovoltaics is more competitive than generating power from non-renewable sources like combined cycle gas and coal (ECLAC, 2022c) (see figure II.6).

Figure II.6
Levelized cost of electricity from renewable and fossil fuel sources, 2021
(Dollars/MWh)



Source: Lazard, *Lazard's Levelized Cost of Energy Analysis: Version 15.0*, October 2021.

The levelized cost of energy varies from country to country, depending on the cost of production factors, regulations, the scale of the economy and the energy transition path. Comparing levelized energy costs using different sources nevertheless serves as a reference point and the results are in line with major renewable energy investments.

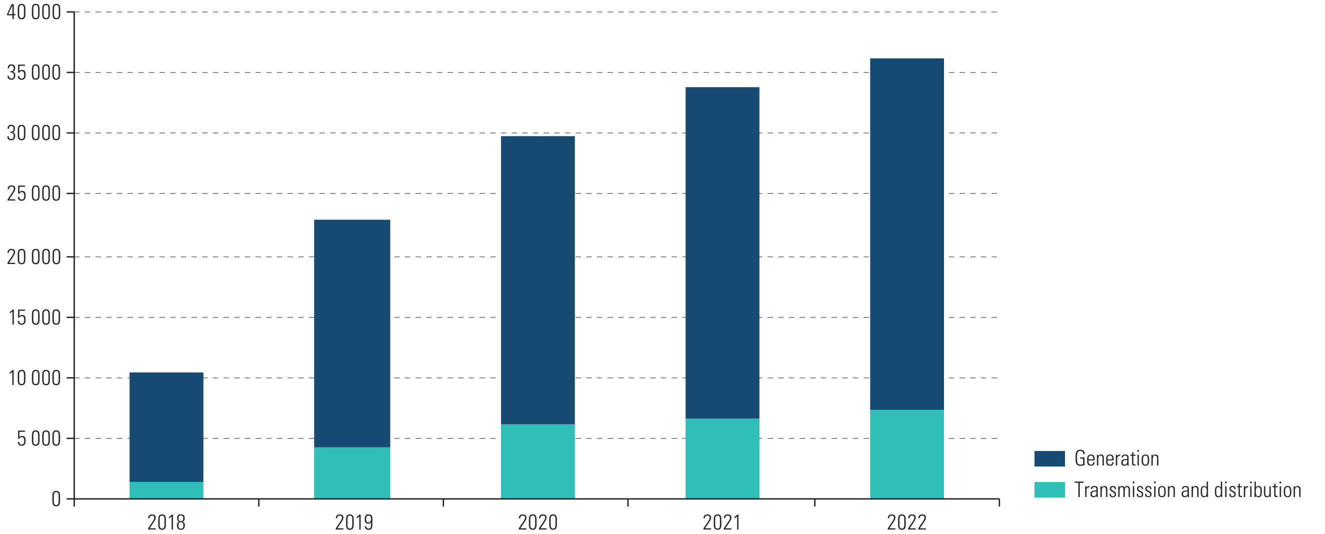
However, the cost of solar and wind power and batteries is not falling fast enough to accelerate the transition and align with decarbonization targets and the SDGs. The main barriers to faster adoption of renewables and the energy transition in the region are increasing pressure on transmission and distribution infrastructure, governance challenges, regulatory shortcomings and the persistence of fossil fuel subsidies, factors that are discussed in depth later in this chapter. Globally, it is estimated that US$ 11 million of coal, oil and gas subsidies are paid per minute, every day. Each year, governments around the world invest some half a trillion dollars into artificially lowering the price of fossil fuels, more than three times the amount going to renewables (Guterres, 2022). Although a price differential that reflects the competitiveness of renewable energies is therefore necessary, it is not sufficient to accelerate the energy transition in the region; instead, a new governance ecosystem is needed (ECLAC, 2022c).

(c) Concentration of private investment in the electricity generation subsector

Probably because of regulatory shortcomings in the region's countries, most private investment in the Latin American and Caribbean electricity sector has targeted generation (see figure II.7), while the necessary transmission and distribution infrastructure has been neglected. As a result, there are significant problems with the power available for balancing daily and yearly supply and demand.

Investment projects for generating electricity from renewables have grown to meet the rising demand, which is expected to last and grow over time, driven by the growth of aggregate demand, urbanization and the progressive electrification of industry and transport in Latin America and the Caribbean.

Figure II.7
Latin America and the Caribbean: evolution of private investment in electricity, 2018–2022
(Billions of dollars at current prices)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, Private Participation in Infrastructure (PPI) Database [online] https://ppi.worldbank.org/en/ppi.

An analysis of the current challenges and of private infrastructure investments in the electricity transmission and distribution subsectors in recent years reveals a clear shortfall when compared with investment in generation. The main reason for the deficit is that these sectors are natural monopolies; active regulation is therefore necessary to encourage investments to expand transmission and distribution lines, which are required for competition between generators. Policies that attract and encourage the transmission and distribution investments needed are therefore important, and they must constantly complement and integrate with electricity price regulations to keep the latter closely aligned with the costs of generation, transmission and distribution. For the same reason, all electricity regulations must contain suitable incentives so that transmission and distribution infrastructure is developed despite limited potential for private profit. In particular, regulatory authorities must actively plan to guide investments and implement mechanisms that encourage interactions among the different electricity sector actors.

In addition, efforts must be made to promote electricity sector sustainability by implementing direct policies —for example, targets or quotas governing the share of renewables in electricity generation— along with policies that send a clear signal, such as reducing or eliminating fossil fuel subsidies, which must aim to promote carbon neutrality over the medium and long term. The oversight role of national regulatory authorities must also be strengthened for the implementation of appropriate mechanisms and instruments to resolve information asymmetries between regulatory authorities and private agents. To that end, regulators must provide clear guidelines and incentives to attract investments in infrastructure. Whether private, state or community, investments must be geared towards furthering sustainability, quality, reliability and resilience, which are essential for universal access and which, if necessary, must be achieved through decentralized distributed generation systems and microgrids that reach the region's isolated and remote areas.

The cases of Chile, Paraguay and Uruguay are useful to illustrate various management methods and mechanisms that could be implemented in the Latin American and Caribbean electricity sector; they also reveal some of the progress made and remaining challenges. The Chilean electricity sector is entirely private and attracts large investments. Most of it has been channelled into the generation subsector, while transmission and distribution infrastructure has attracted little interest, and investment in it is clearly insufficient. As a result, much of the electricity generated from renewable sources must be dumped because the transmission grid cannot receive it the entire time or at certain locations. The Chilean Association of Renewable Energies and Storage (ACERA) estimates that the volume of non-conventional renewable energy dumped will exceed 1,600 GWh in 2023, up from 1,400 GWh in 2022. That figure is equal to all the electricity generated in the country from diesel in 2022 or the annual consumption of 600,000 households (ACERA, quoted in *El Mercurio*, 2023). The Government of Chile has announced a "second phase of the energy transition", in which mechanisms to solve these widely recognized problems will be discussed and implemented. In Paraguay, in contrast, the electricity sector is a state-owned monopoly, and loans from international development banks have generally been used to improve the electricity infrastructure. The National Electricity Administration (ANDE) and the Development Bank of Latin America (CAF) agreed to a US$ 250 million loan for Paraguay's electricity transmission and distribution system improvement and distribution management modernization programme.[6] Uruguay, meanwhile, shows that high incorporation rates of solar and wind renewables are possible if a flexible electricity infrastructure is developed within a regulated market with a strong presence of the State.

To summarize, attracting the investments needed in the transmission and distribution subsectors requires a robust regulatory body capable of appropriately channelling private investment. At the same time, the case of Chile shows that substantive changes can be brought about through a proactive policy that requires a given percentage of generation from renewable sources. This can be achieved primarily by setting targets for the decarbonization of the electricity system. Finally, in Paraguay, although the country has been relatively successful in harnessing its hydropower potential, infrastructure problems still prevent it from being exploited in full.

6 This loan was signed in 2020 to improve the quality of the electricity supply service by providing the distribution and transmission systems with greater reliability, capacity, security and sustainability. The idea was to achieve the goal by reducing system interruptions and downtime, and by improving management through the design, implementation and use of information systems that would enable efficient asset management and provide timely support for planning, projects, works, operations and maintenance. In 2021, ANDE and CAF signed a non-reimbursable technical cooperation agreement for US$ 133,000 to support the execution of a project titled "Study for the implementation of an intelligent system in the management of electricity metering in Paraguay". The project was intended to examine the prevailing situation with the infrastructure ANDE had in place for energy metering and its management system, and to analyse the data collected in order to determine, for each of the country's departments, the most appropriate technological alternatives for ANDE to implement smart metering.

(d) Instruments for regulating and promoting the generation of electricity from renewable sources

The region's States have various regulatory mechanisms and instruments to manage electricity supply and distribution. Thus, Latin American governments have established a variety of mechanisms and instruments to promote the construction of power generation plants with either public or public-private financing. Argentina, Brazil, Chile, Peru and Colombia have introduced long-term contracting systems through regulated tendering processes or auctions. The latter generally include a reliability fee, which has lowered market risks by reducing the amount of energy traded or contracted for on the spot market.

At the same time, the use of renewables has brought about changes in operating methods and the emergence of power purchase agreements (PPAs), which will have to evolve to adapt to the new reality of renewable energies and the energy transition. While traditionally PPAs were long-term contracts between suppliers and users and covered large amounts of energy, distributed generation implies a change in that end-users can obtain their electricity directly from producers. This model has clear economic and environmental potential, since it allows each end consumer to access renewable energies through corporate PPAs. This allows consumers to obtain their energy from renewable power plant operators, which streamlines operations in the sector and also displaces traditional generators that use fossil sources to produce their energy.

Depending on their different contexts and the structure of their electricity markets, the region's countries have used different instruments to promote renewable energy sources, which can be summarized as follows:

- National policies: national or departmental strategies or laws that set targets for the adoption of renewable energies, and laws or programmes that apply to certain specific sources, such as wind, solar and geothermal energy, and biomass and biofuels.
- Regulatory instruments: auctions, feed-in tariffs, quotas, premiums, certificate systems, hybrid systems and net balance. In the case of biofuels, the most common goal is for the percentage of alcohol blended with hydrocarbons to reach 20% in biodiesel and at least 10% in the case of bioethanol in gasoline.
- Tax incentives: exemptions from various taxes at the national or regional level to promote the adoption of renewable energies and more efficient equipment.
- Grid access: exemptions or discounts on transmission tolls, priority access, preferential dispatch and other benefits.
- Finance: currency hedging, specific funds, eligible funds, guarantees, pre-investment support and direct financing.
- Others: direct use of renewable technologies in housing, access programmes in rural and peri-urban areas, water-energy-food nexus, specific socioenvironmental regulations, etc.

In practice, combinations of these instruments and mechanisms are applied and, in some countries, they have been complemented by a premium or supplementary payment on electricity prices for each MWh produced from renewable sources.

For illustrative purposes, a study conducted with information from 2015 identified the types of policies and regulatory instruments that have been implemented for the electricity sector in selected countries of the region (see table II.1).

Table II.1
Latin America (12 countries): regulatory policies and instruments for the energy sector, 2015

Type	Instrument	Argentina	Bolivia (Plurinational State of)	Brazil	Chile	Colombia	Ecuador	Paraguay	Peru	Uruguay	Venezuela (Bolivarian Republic of)	Mexico	Costa Rica
Tax incentives	Value added tax exemption												
	Income tax exemption												
	Import and export tax benefits												
	Local tax exemptions		XX										
	Carbon taxes												
	Accelerated depreciation												
Grid access	Transmission toll exemptions												
	Priority transmission												
	Grid access												
	Preferential dispatch												
	Other grid benefits												
Regulatory instruments	Auctions											XX	
	Feed-in tariffs	XX		XX			XX						
	Premiums												
	Quotas												
	Certification systems												
	Hybrid systems			XX									
	Net balance												
Finance	Currency hedging												
	Specific funds												
	Eligible funds												
	Guarantees												
	Pre-investment support												
	Direct financing												

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Renewable Energy Agency (IRENA), *Renewable Energy in Latin America 2015: An Overview of Policies*, Abu Dhabi, 2015.
Note: "XX" indicates mechanisms that are no longer operating.

(e) Private and public actors in the electricity sector and their relationship with investment

Following the Latin American debt crisis of the 1980s, the region's governments abandoned the development model based primarily on State investment. A process of deregulation and privatization began in various service markets that had traditionally been covered by the public sector and public companies (for example, water and electricity supply). In the energy sector, the electricity market was deregulated, and generation, transmission and distribution to users were privatized. The 1980s and 1990s saw important changes to encourage private investment and create competitive and decentralized wholesale markets, which triggered the privatization of the electricity sector in several of the region's countries. This led to a vertical disintegration of national electricity companies, in which the management of transmission and distribution infrastructure was separated from the management of generation capacity (electricity dispatch). However, in the early 2000s, regulatory frameworks once again became important for guiding private sector investments, and there was a tendency towards increasing the strength of regulatory institutions in the electricity sector.

The electricity systems of the region's countries currently operate heterogeneously in terms of private and public sector participation and ownership in each subsector, for example in the generation, transmission and distribution of electricity (see table II.2). Between 2000 and 2018, the systems can be classified as totally private, totally public or mixed (public-private).

Table II.2
Latin America and the Caribbean (18 countries): private sector participation in the electricity system, 2000 and 2018
(Percentages)

Country/subregion		Generation		Transmission		Distribution	
		2000	2018	2000	2018	2000	2018
North America	Mexico	8	25[a]	0	0	0	0
Central America	Costa Rica	7	20	0	0	0	0
	El Salvador	35	75	0	0	100	100
	Guatemala	47	90	0	30	100	92
	Honduras	39	80	0	0	0	0
	Nicaragua	35	80	0	15	0	95[b]
	Panama	15	97	0	0	0	60
South America	Argentina	58	80	100	100	65	75
	Bolivia (Plurinational State of)	95	10	90	10	90	40
	Brazil	25	45	10	15	55	70
	Chile	88	100	85	100	90	100
	Colombia	30	70	10	15	30	50
	Ecuador	25	10[c]	0	0	40	0
	Paraguay	0	0	0	0	0	0
	Peru	55	90	0	100	80	63
	Uruguay	20		0	0	0	0
	Venezuela (Bolivarian Republic of)	15	0	10	0	45	0
The Caribbean	Dominican Republic	55	70	0	0	0	0

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of special processing of information from the ministries of energy of the region.
[a] In 2023, the public sector share was 54% and the private sector share was 46%.
[b] In 2020, distribution became 100% public.
[c] In 2020, it was announced that foreign investment would be allowed.

Inadequate regulatory frameworks have failed to encourage investment in quality infrastructure, especially in the electricity transmission and distribution subsystems, which are guided strictly by profitability. If authorities were strengthened, interconnections between them were encouraged and a solid regulatory framework were created, progress could be made in addressing the main challenges in the region: lack of access to electricity, shortfall in universal coverage, high and unfair costs paid by the most vulnerable population quintiles, and the various forms of energy poverty. Inclusive and modern electricity sector governance is crucial for achieving universal, fair and sustainable access.

3. Energy intensity and efficiency in Latin America and the Caribbean: room for improvement

Globally, energy efficiency measures adopted between 2000 and 2021 led to savings of around 30% of final energy consumption, equivalent to 125 exajoules (IEA, 2022). The improvements were primarily in industry and transport and were driven by minimum energy efficiency standards and advances in vehicle fuel efficiency. The electrification of transport and the implementation of household appliance standards have also contributed significantly to improving energy end-use efficiency. According to the

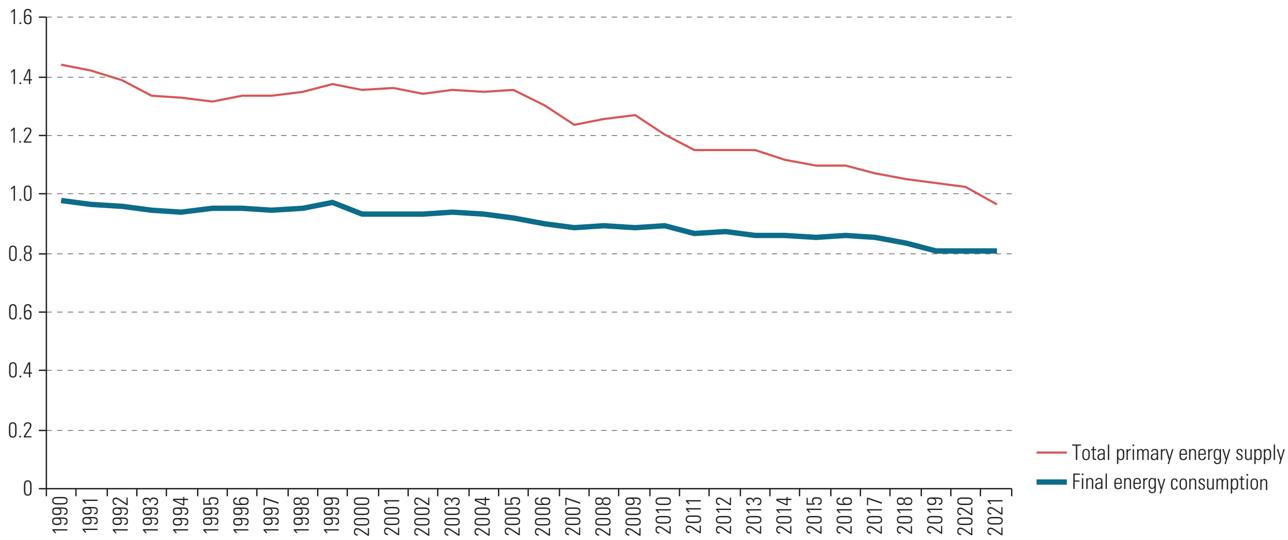
International Energy Agency (IEA, 2022), while there are many ways to address the current crisis, focusing on energy efficiency is the unambiguous first and best response to simultaneously meet affordability, supply security and climate goals. IEA also notes that thanks to the efforts made to conserve and better manage energy consumption since the onset of the crisis, progress with efficiency has gained momentum, with annual energy intensity improvements expected to reach up to 4% per year in a global net-zero emissions scenario. It also proposes improving the energy intensity of economies by 2% per year in the stated policies scenario (STEPS) and by 3% per year in the announced pledges scenario (APS). The renewal of vehicle fleets and industrial facilities poses a major challenge, and effective policies are needed to prioritize energy efficiency in new assets and improve efficiency in existing stock, particularly in certain key sectors, such as buildings.

As this section will show, however, progress with efficiency in Latin America and the Caribbean is falling short of SDG target 7.3, which states that the rate of improvement in energy efficiency should double by 2030. At present, this has only been achieved in one economic sector and in the residential sector. It should also be noted that in recent years, the pace of improvement has slowed in developed countries.

Clearly, increased energy efficiency is also needed to manage the growing demand for energy, especially in emerging countries and developing economies. Energy efficiency gains are currently seen as the primary source of energy for making development sustainable.

In the past three decades, Latin America and the Caribbean has been able to reduce the energy intensity of GDP by a cumulative 18%, while total energy consumption has continued to rise (see figure II.8). This means that although both economic output and energy use have risen in absolute terms over time, the region's economy has been able to produce increasing amounts of goods and services using the same amount of energy per unit or less, so there has been a slight decoupling between economic output and energy use.

Figure II.8
Latin America and the Caribbean: energy intensity of GDP, 1990–2021[a]
(Barrels of oil equivalent and 2018 dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

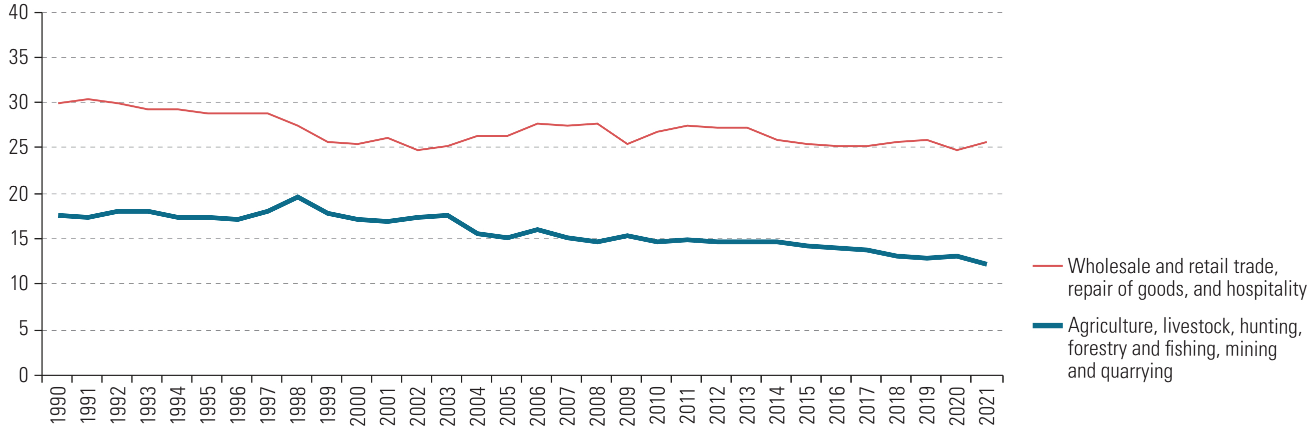
[a] Energy intensity is expressed as the ratio of total primary supply (red) or final consumption of energy (blue), expressed in barrels of oil equivalent, to GDP, expressed in thousands of 2018 dollars.

Additionally, if energy efficiency is measured in each of the region's productive sectors, those that continue to lag can be clearly identified. Using OLADE statistics on sectoral energy consumption and ECLAC statistics on value added by economic activity, the preliminary conclusion is that in the region as a whole, the only sector showing a slight increase in efficiency is transport, storage and communications, which accounts for 36% of the region's energy consumption. This increase may have occurred in response to rising relative hydrocarbon prices, as well as technological improvements and stricter regulations. At the same time, a slight downward trend is reported in the energy efficiency of manufacturing industries, agriculture, fishing and mining, and commerce and other services (see figures II.9 and II.10).

Figure II.9

Latin America and the Caribbean: energy efficiency in the trade, agriculture, mining and other sectors, 1990–2021[a]

(Kilograms of oil equivalent and 2018 dollars)



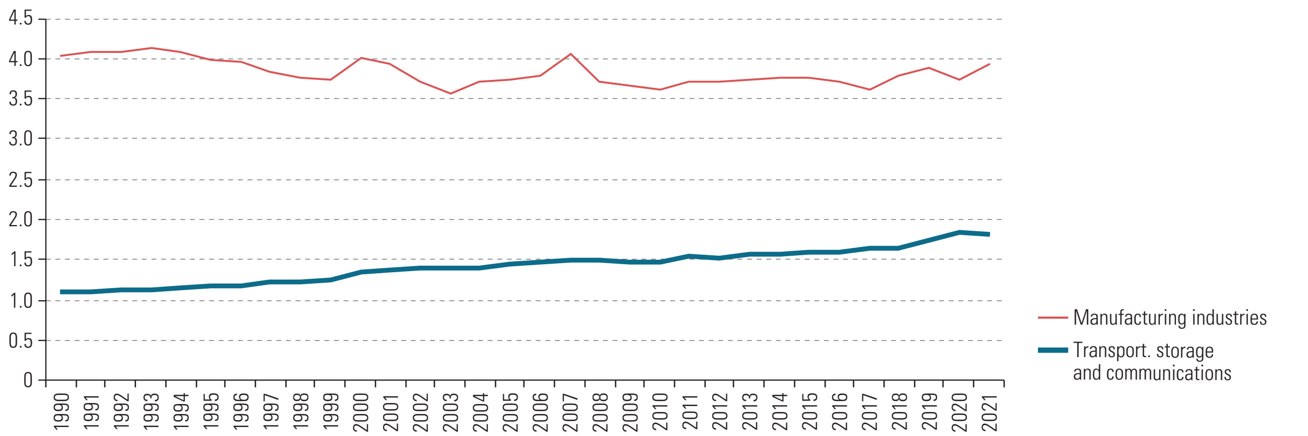
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

[a] Energy efficiency is the ratio of final energy consumption in kilograms of oil equivalent to value added in 2018 dollars.

Figure II.10

Latin America and the Caribbean: energy efficiency in the industrial, transportation and other sectors, 1990–2021[a]

(Kilograms of oil equivalent and 2018 dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and Latin American Energy Organization (OLADE), Energy Information System of Latin America and the Caribbean (sieLAC) [online database] https://sielac.olade.org.

[a] Energy efficiency is the ratio of final energy consumption in kilograms of oil equivalent to value added in 2018 dollars.

This energy efficiency lag in various productive sectors could be caused by a series of structural obstacles, including insufficient viable and cost-effective solutions, inadequate regulatory frameworks and incentives, lack of access to specialized services, and problems accessing financing, especially in the case of SMEs. Given the vast potential of efficiency for managing growth in energy demand, further studies are needed to determine the underlying causes of the lag. The realization of that potential can transform efficiency into what could be described as a new old energy source and delay the need for more generation and increased emissions (in the case of fossil sources), relieving pressure on natural resources to strengthen progress towards sustainable development.

The energy efficiency policies, solutions and measures implemented in Latin America and the Caribbean are concentrated in the residential sector and, to a lesser extent, in transport and industry. Those measures have been stepped up since 2010, with almost 75% of the total implemented since then. At present, most Latin American and Caribbean countries have energy efficiency laws and programmes, although many of them lack quantitative targets. The largest number of energy efficiency measures in the region have been adopted in the residential sector (40%), followed by the transport sector (20%); moreover, an increasing number of Latin American and Caribbean countries are monitoring the impact of the policies and measures implemented using energy savings or energy efficiency indicators.

In its work on energy efficiency with the countries of Latin America and the Caribbean, the United Nations Environment Programme (UNEP, 2023) identified numerous opportunities for energy efficiency savings in lighting, appliances and equipment. By way of illustration, comparing forecasts for electricity consumption increases by 2030 (15%) and a relatively achievable scenario involving policies that impose minimum energy efficiency standards, annual electricity consumption could be reduced by 76 TWh, saving the equivalent of the energy production of 35 power plants, reducing CO_2 emissions by 48 million tons and cutting US$ 9 billion from the region's electricity bill.

4. Energy service coverage and energy inequality and poverty in Latin America and the Caribbean

The impacts of the pandemic and its subsequent repercussions, the conflict in Ukraine, and cascading crises in the region have directly increased energy vulnerability. Rising prices for fossil fuels (gas, oil and coal) and difficulties in paying electricity bills are two clear examples. These shocks have amplified overall inflation through higher energy and transport costs for goods and services, hitting households in the most vulnerable quintiles the hardest.

In recent decades, however, the region has made significant progress in electricity access and connections, through which electricity services were available to 97.6% of the population in 2021 (OLADE, 2022). Most of the 16.1 million people in Latin America and the Caribbean without electricity live in rural and remote areas where the cost of extending networks and infrastructure runs high. Although the situation varies widely, there are countries in the region where up to 15% of the rural population lacks access. In South America, 4.9 million people do not have electricity, and in Central America, the figure is 3.7 million (OLADE, 2022).

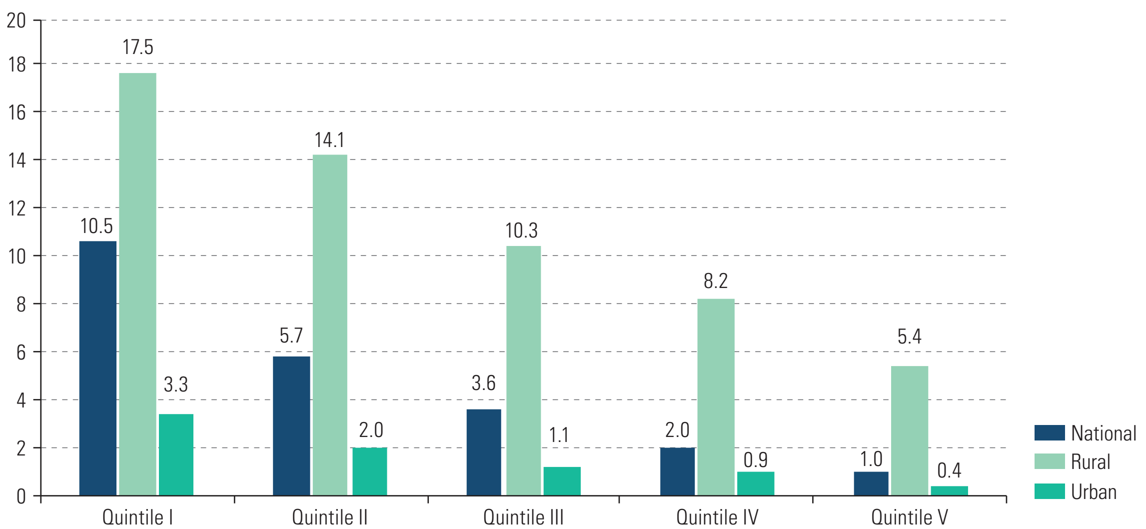
Since Latin America and the Caribbean is the world's most unequal region, a multidimensional analysis is required of the many factors underlying lack of access, through the concept of energy poverty.[7] These factors better reflect territorial inequalities

[7] Energy poverty is the inability to meet energy needs, including the standards for equal access in both quantity and quality (lighting, heating and cooling, food preparation and preservation, information and communications technology, affordable rates and other needs).

and specificities. Vulnerable households face higher rates of lack of access to quality energy services because of problems of accessibility (insufficient infrastructure or limited or precarious access) or affordability (families cannot afford the service or have other priority needs, such as food or health).

On average, the access to electricity of the region's most vulnerable quintile is one ninth that of the highest income quintile, a gap that is nearly double for rural populations (see figure II.11). At the same time, 78 million people lack access to clean fuels and technologies for food preparation (ECLAC, 2023a), the result of which is pollution and deteriorating family and environmental health. In 2021, 15.5% of the region's population living in precarious housing lacked access to electricity (ECLAC, 2023a). The physical dimension of electricity access encompasses not only poor-quality housing, but also the structure of the home environment and inefficient and worn-out appliances.

Figure II.11
Latin America and the Caribbean: rural, urban and total population without access to electricity, by income quintile, most recent year available
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of household income and expenditure surveys of the region.

Indicators predating the pandemic and the conflict in Ukraine already showed that a large proportion of household spending was allocated to fuel, as much as 10% of the total, a proportion that rose across all population groups following the recent external shocks. Electricity can account for up to 5% of household spending and, in most countries, the burden on the most vulnerable quintiles can be up to four times higher than for the higher income strata.

Obviously, access to electricity has multiple benefits for quality of life. For example, schools benefiting from electricity access programmes report lower dropout rates, especially in the early years and in rural areas (Mejdalani and others, 2018). Economic poverty in the region is clearly correlated with the main characteristics of energy poverty, such as lack of access to electricity, clean fuels or electric appliances. In addition, in the countries of Latin America and the Caribbean where the human development index (HDI) is lower, the relative lack of access to these services is higher, and the poorest quintiles have less access to clean fuels (which can be almost 50% lower than in the highest income quintile) (ECLAC, 2009). At the same time, the region's Indigenous and Afrodescendent populations are among the most vulnerable, outnumbering by a factor of two those who lack access to electricity among non-Indigenous and non-Afrodescendent populations.

Gender inequalities as they relate to energy take the shape of difficulties in accessing clean energy sources for cooking and responsibilities related to securing and managing energy for the household (firewood, biomass), tasks that can be very time-consuming and can threaten the safety and health of women and girls. Similarly, the use of energy sources such as firewood and biomass is associated with health problems caused by pollution inside the home, which is further evidence of the barriers hindering progress towards other SDGs that arise due to the energy poverty of many of the region's female heads of household (UNDP, 2018; ECLAC, 2021).

Overcoming energy poverty requires an analysis that goes beyond the universalization of coverage to improving social conditions and boosting household incomes. In order for Latin America and the Caribbean to achieve universal electricity access, and for the supply to have the necessary quality and be derived from sustainable and clean sources, the most disadvantaged and remote sectors must be addressed, in other words the most vulnerable populations, those living in remote or isolated territories, Indigenous and Afrodescendent people, and women and girls. Achieving that goal requires an appraisal of the potential of decentralized energy models (distributed generation) for community-based generation of clean and sustainable energy or the extension of the same essential services to the entire population of remote or isolated territories. Because grids and infrastructure are insufficient, local or stand-alone renewable energy sources —such as micro-hydro, wind or solar energy— can be harnessed, with a consequent reduction in greenhouse gas emissions and air pollution from fossil fuels. In addition, the use of decentralized power generation technologies can reduce household electricity bills (ECLAC, 2022a).

5. Progress and challenges of foreign investment in renewable energy in Latin America and the Caribbean

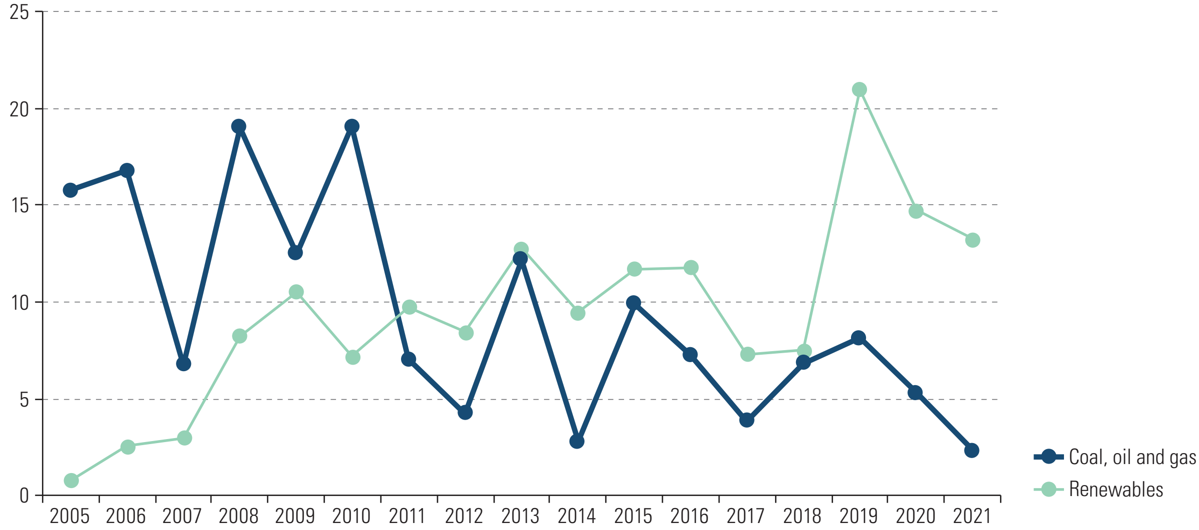
Given the limited fiscal space available in the region's countries to increase public investment in renewable energy and energy efficiency to the levels needed to accelerate the energy transition, governments must adopt sound policies and implement suitable instruments to attract private investment.

To achieve the targets set, IRENA (2021) estimates that investments in renewable energy will need to double before the end of this decade and then continue to grow, to triple the current levels; hence, private funding will need to provide most new investments. IRENA/CPI (2020) indicates that the main source of financing for renewable energy investments in the world is the private sector, accounting for 86% of the total in recent years. Although public financing contributes only 14%, those funds are indispensable for reducing risks, attracting investment, overcoming initial barriers and reducing capital costs, all of which are key elements in the necessary expansion and scaling-up of new projects.

Latin America and the Caribbean have reported a large number of foreign direct investment (FDI) announcements in renewable energies, and in recent years, the region has established itself as an attractive market for the development of energy transition projects. In 2021, renewable energy project announcements accounted for 20% of total regional FDI, supplemented by announcements in the fields of telecommunications (20%), high-tech industries (6%), software and IT services (3.5%) and food and beverages (5%).

As shown in figure II.12, since 2011, there have been more FDI projects for renewable energies in the region than for fossil fuels. This trend is expected to rise over the long term in keeping with the region's decarbonization commitments and energy transition strategies.

Figure II.12
Latin America and the Caribbean: foreign direct investment project announcements, by energy source, 2005–2021
(Billions of dollars)

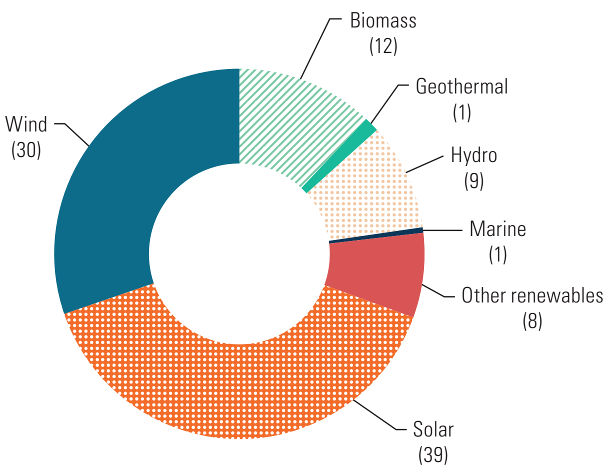


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of *Financial Times*, fDi Markets.

Renewable energy sector FDI announcements in Latin America and the Caribbean totalled US$ 159.2 billion between 2005 and 2021. In keeping with the global trend, solar and wind energy accounted for most of the region's investments, representing 39% and 30% of the total, respectively. They were followed by FDI announcements in biomass energy (12%), hydropower (9%), geothermal energy (1%) and marine energy (1%) (see figure II.13).

The distribution of renewable energy FDI by country shows that over the 2005–2021 period, Chile accounted for the largest share of the investments announced (30% of the total). It was followed by Brazil (27%), Mexico (19%), Colombia, Panama and Peru (4% each), Argentina (3%), and the Dominican Republic and Uruguay (2% each). The remaining countries commanded less than 1% of total FDI announced in the renewable energy sector.

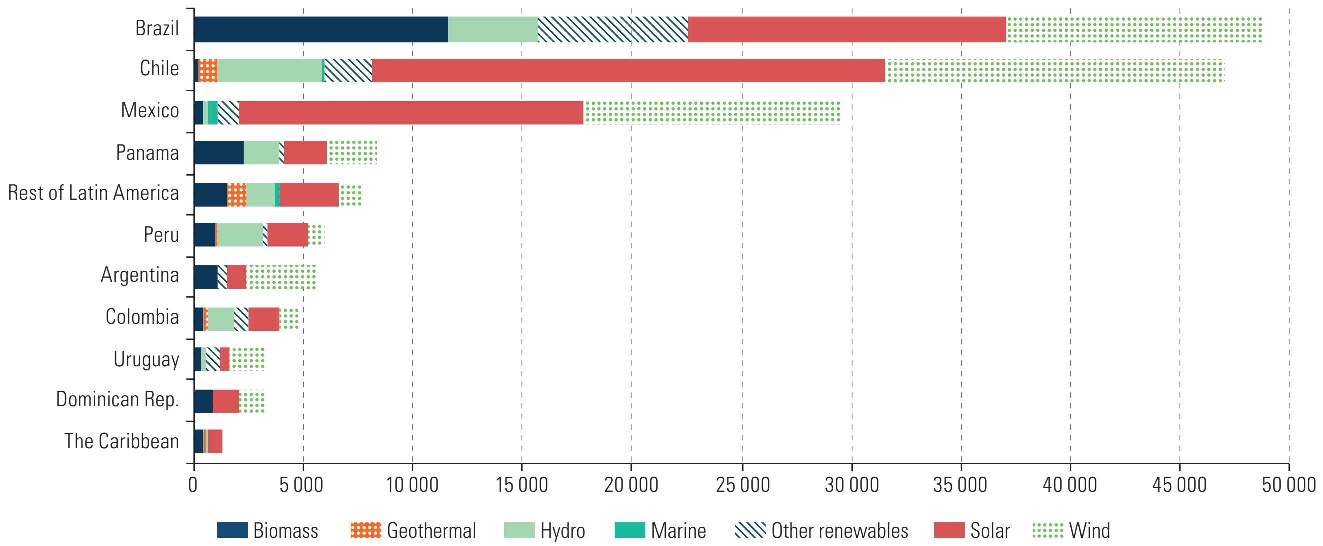
Figure II.13
Latin America and the Caribbean: foreign investment announcements in renewable energies, by source, 2005–2021
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of *Financial Times*, fDi Markets.

As regards the type of renewable energy involved, the largest investments in the three main FDI recipients (Chile, Brazil and Mexico) were for solar, followed by wind; in Brazil, however, energy generation projects using biomass were also notable. In Argentina, Uruguay and Panama, the main investments were for wind energy, while FDI announcements for solar energy in Colombia and the Dominican Republic and for hydroelectric power in Peru were also notable (see figure II.14).

Figure II.14
Latin America and the Caribbean: foreign investment announcements in renewable energies, by source and main countries, 2005–May 2022
(Millions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of *Financial Times*, fDi Markets.

6. New renewable energy developments in Latin America and the Caribbean: electromobility, critical minerals, storage and green hydrogen

In addition to the deployment of new renewable energies, such as solar- and wind-based electricity and their storage technologies, the region reports three new strategic developments in support of the energy transition: (i) the electrification of transport and mobility using renewable sources, especially in cities, (ii) the use of critical minerals (for example, lithium and copper) needed for the energy transition, and (iii) progress with the new green hydrogen industry.

(a) Renewable electrification of the region's transport

The transport sector is the largest energy consumer in the region, and at present, it relies almost entirely on internal combustion engines powered by fossil fuels. Likewise, the sector's greenhouse gases account for a large share of all emissions from energy. The sector is therefore of high strategic importance in decarbonizing the economy through renewable energy-based electrification, the creation of mechanisms to modernize public and private transport with recharging systems, and the promotion of digitization to obtain an efficient and intelligent system. Similarly, electromobility represents an opportunity to clean the air in urban areas and improve the population's health.

The region is making slow progress with electromobility: it relies mainly on imports of buses, private cars and their associated technologies, and productive capacity needs further strengthening. Despite the fact that the region has the capacity to produce electric vehicles, 99% are currently imported from China.[8]

Table II.3 shows that the potential annual reduction in CO_2 emissions in four large cities in the region is equal to 80 million tons for passenger vehicles and 2.27 million tons for buses, an average reduction of nearly 17% in national transport sector emissions.

Table II.3
Latin America and the Caribbean (four cities): estimated annual reduction in greenhouse gas emissions made possible by sustainable electromobility

City	Reduction of private vehicle emissions *(Millions of metric tons of CO_2/year)*	Reduction of passenger bus emissions *(Millions of metric tons of CO_2/year)*	Share of national transport sector emissions *(Percentages)*
Bogotá	3.72	0.18	16.3
Buenos Aires	7.12	0.68	22.1
São Paulo	41.16	1.27	13.3
Mexico City	24.87	0.14	16.0
Total	**78.87**	**2.27**	**16.9**

Source: Economic Commission for Latin America and the Caribbean (ECLAC).

The transport sector has been prioritized as it is key to achieving the emission reduction targets set in the nationally determined contributions (NDCs) of 27 of the 33 Latin American and Caribbean countries. At present, most Latin American and Caribbean countries have laws providing various instruments to encourage the introduction and use of electric vehicles. In addition, the countries that have already designed productive development plans and electromobility strategies include different approaches to addressing transport, for example through public policies and legislation on electromobility products and services. However, the scale of those measures remains insufficient. Since 2020, notable progress has been made in the installation of electric vehicle charging stations, public and private alike. In addition, some companies have pilot projects to convert buses and vehicles that have reached the end of their useful life, adapting them and installing electric motors. In some cases, vehicles are even being manufactured to offer new transport solutions.

(b) Critical minerals for the storage and promotion of renewable energies in Latin America and the Caribbean

Implementing an energy mix that contains more renewables means developing the infrastructure for production, storage, transmission and electrification of transport. Because of their variable nature, some of the main clean and renewable energy technologies —such as solar and wind energy— require storage. Others, such as solar hydrogen, can be stored and are themselves dense, clean and renewable energy carriers and vectors. The renewable energy storage industry is therefore a new value chain that should be established and developed in the region's countries. Storage entails the use of new kinds of batteries: not just lithium-ion batteries, but also others that are currently being researched and developed or are at the scale-up stage, such

8 The region has expertise and experience in the manufacture of internal combustion vehicles. Mexico and Brazil are the two manufacturing and export centres: they produce 10% of the world's vehicles, totalling around half a million a month. The industry generates 900,000 direct jobs in Mexico and more than 500,000 in Brazil (Messina, Contreras Lisperguer and Salgado Pavez, 2022).

as sodium batteries. All of this will boost demand for critical minerals to advance the energy transition and promote electromobility.[9]

The energy transition will trigger soaring demand for these minerals, which are extremely abundant in Latin America and the Caribbean. The challenge is to manufacture new energy products here instead of merely exporting raw materials, as has been the trend to date, in order to create and retain green jobs, produce more value added and raise household incomes in the region.

Latin America and the Caribbean are generously endowed with the critical minerals needed for the energy transition, holding 51% of global reserves of lithium, 38% of copper, 22% of natural graphite, 39% of silver, and 17% of nickel, zinc and rare earth elements. The region produces 40.6% of the world's copper and 32.2% of its lithium.[10] Moreover, demand for these minerals will spike. IEA (2021) estimates that in the sustainable development scenario in which the targets of the Paris Agreement are attained, global demand between 2020 and 2040 could expand by a factor of 42 for lithium, 25 for graphite, 21 for cobalt, 19 for nickel and 2.7 for copper.

In the same vein, ECLAC estimates that the expansion of Latin America's electricity capacity by 2032, led by renewables and against a backdrop of regional electricity integration, will require 47 GW generated by solar power and 75 GW generated by wind. To achieve this capacity, the demand for generation and transmission facilities is expected to total 611,000 tons of copper, 53,300 tons of nickel, 2,500 tons of cobalt and 2,100 tons of lithium.[11]

(c) The new green hydrogen industry in Latin America and the Caribbean

Promoting the transition to new development models using clean and dense renewable energy in Latin America and the Caribbean requires strengthening the new green hydrogen (GH_2) industry.[12] GH_2 is produced with renewables, such as solar and wind energy, which are widely available in the region and are highly cost competitive. GH_2 is a very flexible energy source, suitable for use in energy-intensive sectors such as heavy industry (for example, cement or steel) and transport (cargo, shipping and aviation). Electricity from renewables powers electrolysers that separate hydrogen from water molecules, producing both hydrogen and water vapour as a waste product. GH_2 can produce, store and carry the renewable energy that will drive new carbon-neutral economies and sustainable production over the coming decades. GH_2 is therefore a very important innovative industry for the energy transition in the region, which has a large endowment of renewable energies and the technological and engineering capacity to create and capture value added along the entire value chain. This is the great challenge that must be met in order to decarbonize, drive the energy transition and, at the same time, reactivate national economies.

The new GH_2 industry is well under way in the region and uses electrolysers powered by solar and wind energy, although production is not yet on a commercial scale. In 2022 there were 12 GH_2 projects operating in Argentina, Brazil, Colombia,

9 The countries and the institutions involved in the industry define different minerals as critical. In addition, in many of the region's countries, minerals deemed critical for the energy transition are called "strategic minerals" because they play a significant role in national development.

10 In copper production, the contributions of Chile (26.7%) and Peru (10.5%) stand out as they are the world's largest and second-largest producers, respectively. Chile is the second-largest producer of lithium (24.8%) and Argentina is the fourth-largest (5.9%).

11 The projections refer to the more optimistic Connected Renewable Energies Scenario (CORE), with highly integrated intraregional transmission and a high share of renewable energies, as much as 80% in 2032 (see Leañez, 2022).

12 In 2021, 95% of the world's hydrogen supply was produced from fossil fuels and was not green. Latin America and the Caribbean produce 5% of the world's grey hydrogen, which is obtained from steam-reformed natural gas and is used as an input in the production of ammonia, methanol and steel, and in refineries.

Costa Rica, Chile and Peru, with green hydrogen being used for transport (buses, trucks and ships), electricity reinjection and mining (as a replacement for diesel). In addition, 71 projects are being developed in the same countries and in French Guiana, Mexico, Paraguay, the Plurinational State of Bolivia and Uruguay. GH_2 is already a priority issue on the energy agenda of Latin America and the Caribbean, and several countries have strategies, road maps and policies for its development that are in line with the objectives of the energy and climate transition. Finally, some of the region's countries are participating in discussions to establish GH_2 certification mechanisms to harmonize its definition in this new industry.

B. Energy transition proposal: prospects in Latin America and the Caribbean

The regional energy transition should be understood as a process of sustainable transformation towards a new enabling ecosystem that interconnects the design and enforcement of public policies, the adaptation of institutions and the creation and implementation of new regulations. In this way, the region will advance and accelerate in multiple dimensions simultaneously, including justice, by universalizing access to electricity for the entire population, increasing energy efficiency and modifying the energy and electricity mix that is essential to economic sectors and patterns of production and consumption.

1. The region's cascading crises and energy transition

As narrated above, the cascading crises, such as the pandemic and the conflict in Ukraine, led to a sharp increase in oil, gas and coal prices, resulting in generalized inflation, low economic growth and higher poverty. This further revealed the fragility of energy production, especially in net hydrocarbon-importing countries, but also in those with poorly diversified energy mixes and low renewable use.

Although the production and refining capacities of the region as a whole, if fully utilized, would be enough to supply all the region's countries with crude oil and various petroleum derivatives, the realization of that potential is hampered by considerable technical, economic, political, institutional and infrastructural challenges.

While the region as a whole has a renewable electricity mix and is somewhat more resilient than other regions, its structural dependence on fossil fuels for economic activities —particularly transport and industry— leaves most of its countries vulnerable to external and supply shocks, even though some fossil fuel-rich countries may benefit from increased revenues in the short term.

In that context, improving regional energy security and resilience to external shocks requires progress with a regional agenda that promotes energy interconnection and integration, the diversification of renewable energy sources and distributed generation based on the renewable resources that are widely available locally.

The pandemic and the conflict in Ukraine and their repercussions showed that such shocks can either drive the energy transition by accelerating the adoption of renewables, or, in fossil fuel-producing and -exporting countries that capitalize on high fossil fuel prices, delay its progress (ECLAC, 2022b).

The additional revenues earned by oil-producing countries from higher market prices could be invested in infrastructure, incentives and renewable technologies, or they could finance transitional energy and general subsidies for the most vulnerable families.

The acceleration or delay of the energy transition in each country on account of the conflict in Ukraine will depend on several factors: (i) the duration of the conflict; (ii) the success of initiatives to tap strategic reserves of oil and natural gas or to increase output; (iii) each country's energy balance (net exporter or importer of hydrocarbons); (iv) the productive structure of each economy; and (v) the relative prices of energy services and the presence of subsidies. So far, countries are resolving major challenges by emphasizing the national perspective, without taking sufficient advantage of the economies of scale and complementarities that could be achieved by cooperating and promoting subregional and regional integration in energy production, transmission and distribution to support the way forward in the energy transition.

2. Pillars for accelerating the energy transition in the countries of Latin America and the Caribbean

The energy transition recommended by ECLAC involves the countries of Latin America and the Caribbean simultaneously making progress with five pillars:

(i) Universalizing access to renewably sourced electricity and reducing energy poverty in all territories by promoting a just transition.

(ii) Accelerating the incorporation of renewable energy into countries' energy mixes.

(iii) Increasing energy efficiency in all economic sectors: transport, industry and the residential and buildings sector.

(iv) Strengthening complementarity, integration and interconnection among the region's energy systems.

(v) Increasing the security of the region's energy and its resilience to external shocks.

This multidimensional transition is fully aligned with the 2030 Agenda for Sustainable Development and the SDGs, and more specifically with the targets of SDG 7. Since the energy transition road map is different in each country, it is more accurate to speak of "energy transitions". An individual country's path will depend on its energy mix, endowment of natural resources, position as a net importer or exporter of fossil fuels, electricity coverage rates, long-term energy planning strategy and decarbonization policies and goals.

Progressively transitioning from fossil fuels and polluting energies to clean, renewable and sustainable energy produces additional benefits. Energy transition strategies reduce greenhouse gas emissions, favour the development of the productive system —with new industries and the value added and green jobs they create— decentralize infrastructure, reduce inequalities in energy access using distributed generation, promote progress towards regional energy resilience and security and help protect the population's health.

Over the past decade and in recent years in particular, technological progress for renewable energy (especially in solar, wind and storage), advances in digital technologies and rapid cost reductions, primarily on account of support from public policies, have attracted domestic and foreign investment, which has had a positive impact on the region. However, markets and market signals are not enough to accelerate the energy transition that the region needs: each country must build or strengthen an enabling ecosystem in which governance is strengthened, long-term energy and strategic planning is conducted and coherent and integrated public policies and instruments are developed in the different sectors.

3. Public policy guidelines to accelerate the energy transition in the region's countries

ECLAC has conducted studies of achievements and challenges in the region's countries and, as a result, recommends the following series of public policy guidelines in order to make greater progress with the energy transition:

- Increase investments to boost the incorporation of renewable energies, develop transmission and distribution infrastructure, increase coverage and universal access to electricity, and also create green jobs and generate new income. Investments must be made with public, private or community resources, depending on the requirements and territory of each project. ECLAC has estimated that if Latin America and the Caribbean were to invest the equivalent of 1.3% of regional GDP every year for a decade, the region would be able to advance universal access, increase regional electricity integration, generate electricity with a high percentage of renewable sources, reduce CO_2 emissions by 31.5% and, at the same time, create 7 million new green jobs and the incomes they would generate (ECLAC, 2020). The national investment needed would be more or less than the regional average indicated above, depending on the renewable content of the country's primary energy and electricity supplies, the level of coverage of quality energy services, and the opportunities for interconnection and energy integration with other countries and subregions.
- Universalize electrification based on renewable energies, leaving no one behind and taking advantage of the potential of combining renewable technologies, so that electricity can be supplied on site in a decentralized way (distributed generation) in rural, remote or isolated communities not served by interconnected systems.
- Incorporate measures that promote the energy transition in strategic sectoral industrial policies: for example, supporting the manufacture of equipment, parts and components, as well as engineering services and the maintenance and operation of generation parks based on various technologies. Energy efficiency solutions —such as the digitization of control mechanisms and combining sources to balance supply and demand in residences, buildings and territories— also offer an opportunity to promote industrial development and high value-added services. At the same time, the promotion of distributed energy poses special challenges for the sector that services and maintains small installations. Governments can support such initiatives in several ways: by encouraging the participation of national or regional producers in public tendering; by designing regulatory frameworks that, through regulation and standards, ensure greater market access for companies and the expansion of energy transition markets; by funding research and development (R&D) to increase competitiveness or adapt products to specific requirements; and by financing the scaling-up of local or regional producers.
- Develop new value chains in the new renewable energy industry, so that it becomes a vector of economic recovery that transforms development models and promotes energy security. What is important is to refrain from repeating the history of importing all the machinery and know-how from the world's industrial centres and only export minerals and commodities, but instead to progressively develop the new industry value chains and retain the surplus profits and earnings so that they remain in national economies. The region has the skilled human capital and critical raw materials to significantly boost renewables and energy efficiency and retrofit solutions (for example, the

electrification of transport and industry), as well as the production and storage capacity needed to deploy solar, wind, batteries and green hydrogen. A greater proportion of renewable energy inputs, equipment, technologies and know-how sourced from within the region means greater energy security and resilience to external shocks such as supply chain disruptions and geopolitical conflicts.

- Boost demand for renewable energies. Allowing the market alone to guide investments would not enable renewable energies to be implemented with the speed required to achieve the energy transition. In fact, the currently competitive prices of solar and wind power and of batteries have not been enough to accelerate the transition in the region's countries against the backdrop of the external shocks of the last five years. Developing these energies requires bolstering both supply and demand from new industries. In the case of green hydrogen, for example, induced demand stimulates the supply of clean renewables in that it provides investors with security regarding future purchases of output. This can be achieved through long-term national policies and plans that establish achievable goals and build consensus between the visions of the State, the private sector and communities. Such policies and plans can use mechanisms ranging from regulations and economic instruments —such as subsidies and incentives for productive enterprises, institutions and households— to the dissemination of information and training on energy efficiency and renewability, as well as nudging, in the context of choice architecture.
- Unlock financing to accelerate energy transitions, which entails overcoming the inadequacy of regulatory mechanisms and erroneous perceptions of risk, and at the same time strengthening technical capabilities to design bankable and scalable projects in new industries. Blended finance is needed to provide the structures needed to close existing financing gaps and unlock the billions of dollars held by private actors, which means adjusted risk frameworks and more flexibility to scale up funding for renewables (Guterres, 2022).
- Strengthen governance, participation and public-private cooperation. Experiences at both the pilot and commercial scales in Latin American and Caribbean countries show that citizens and local communities should be more involved in projects from the outset to boost decentralization and informed participation and reduce the potential for conflict. People's capabilities and willingness to participate, with their diverse resources and needs, are a key factor, from communities that live in the territory and can access decentralized energy from self-generation and microgrids to people who live in large urban areas and consume energy in their homes, buildings, industries and transport.
- Strengthen long-term planning so countries are aware of their energy supply and demand, conduct any necessary prospective analyses, and determine the scope and location of the investments needed in generation, transmission and distribution, both in their territories and nationally, with a medium- and long-term view.
- Build and strengthen subregional and regional energy interconnectivity and integration to increase economies of scale and project viability and step up efficiency and sustainability by distributing dispatchable energy according to the complementarity of supply and demand, particularly in the case of renewable energies characterized by variabilities. This includes both electricity grids and existing gas pipelines, which can be repurposed to carry clean fuels, such as green hydrogen. Integration will also enable uncertainty, volatility and external shocks in the energy field to be met with greater preparedness, and will allow for the establishment of national, regional and subregional energy security and

resilience systems that can function effectively. This requires fostering and maintaining dialogue between policymakers, the private sector, communities and stakeholders in each country and in the region.

Both rising fossil fuel prices and the technological advances that are improving the competitiveness of renewable energy sources and their storage favour the emergence of the context needed to implement these recommendations. However, the current scenario of low economic growth, inflation, increased extreme poverty and rising fuel prices will play an important role in the transition's progress or stagnation, and those factors are discussed below.

4. Governance of the energy transition

Energy resource governance entails the capacity to govern with public, private sector and civil society stakeholders, in order to incorporate their views and improve the distribution of power to fine-tune the management of the energy transition in an interconnected and holistic way. This will enable progress in progressively establishing a nurturing ecosystem for the energy transition, which must include institutional strengthening, a modern and appropriate regulatory framework and long-term energy planning to define, direct and efficiently coordinate public policies.

(a) Principles for energy system governance

Strengthened and adequate governance for accelerating the energy transition implies modernizing and interconnecting institutions and their roles and designing and implementing a regulatory framework that includes countries' policies governing the ownership, exploitation, production and distribution of energy resources. The goal is to structure the regulatory and policy framework in such a way as to maximize its contribution to the production of different energy products and services that are increasingly sustainable and clean, thereby contributing to the sustainable development process in accordance with the principles of inclusivity and environmental sustainability. This requires the implementation of a comprehensive set of policy guidelines and public management capacities and, as such, entails reviewing and strengthening the institutions and instruments that enable that contribution, including resource rent (see chapter I).

States and their administrations have several instruments to influence the natural resource sectors in general and the energy sector in particular, including the following:

- Establishment of an institutional framework among the different levels of government that is specifically dedicated to regulation and oversight of the operations of natural resource-based productive sectors, including energy.
- Specific legislation and regulations in all segments of the energy value chain, for both hydrocarbons and renewables, and in the electricity sector (generation, transmission and distribution).
- Planning and design of sectoral, cross-cutting and energy-specific policies, and regimes for public-private participation in investment and development.
- Direct participation in the development of resources, including energy resources, through public companies (both national and regional).
- Public management of socioenvironmental conflicts, and mechanisms for participation and conflict resolution.

Thus, the premises or conditions for effective governance of the energy transition should cover several areas of those policies and instruments: defining, redesigning or strengthening existing regulatory frameworks and their policy instruments so that natural resources can better contribute to inclusive and sustainable development; and redesigning tax regimes to ensure the efficient investment of rent in a sustainable development process. The instruments should be structured within the fiscal pact between central and subnational governments (provinces or municipalities) and should be equipped with clear criteria for their allocation and application, as done successfully in some countries.

Projects for the exploitation of non-renewable and renewable energy resources can have economic, environmental and social impacts, and these need to be identified, explored, disclosed, mitigated or offset, prior to the launch of the project, throughout its life cycle and up to its closure.

In light of the social conflicts that occur in the region's countries, a new balance must be forged in relations between the State, the market and society; consideration must also be given to the fact that the cascading crises that have occurred in the region demand significant fiscal restrictions, which will hinder the allocation of public financing to meet many of the population's needs in addition to the requirements of the energy transition.

The management of natural and energy resources requires accountability to a properly informed civil society so that revenue use and distribution can be monitored. For that reason, effective mechanisms must be maintained for citizen information and participation. In that regard, the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement) establishes a foundation for achieving those goals.

(b) Governance frameworks for energy transition

In light of national experiences and various case studies (Lange, Page and Cummins, 2018), it is recommended that countries establish a team dedicated to managing the energy transition based on the lessons learned from successful local and subregional experiences (for example, in the Norte Grande between Chile and Peru, and in the Mesopotamian region between Argentina and Paraguay).[13] Good governance requires working with such a specialized energy transition management team, which must take a leading role in assimilating and learning from best practices and in policymaking. The team must also promote interactions —in places non-existent at present— between different ministerial levels, between the different authorities involved in the development of local projects and between other bodies involving two or more countries.

In addition, national managers can benefit from regional exchanges of experiences through networks, observatories and regular meetings that are already in operation, such as the Observatory for Renewable Energy in Latin America and the Caribbean, the Regional Forum of Energy Planners (FOREPLEN) and the OLADE Energy Week.

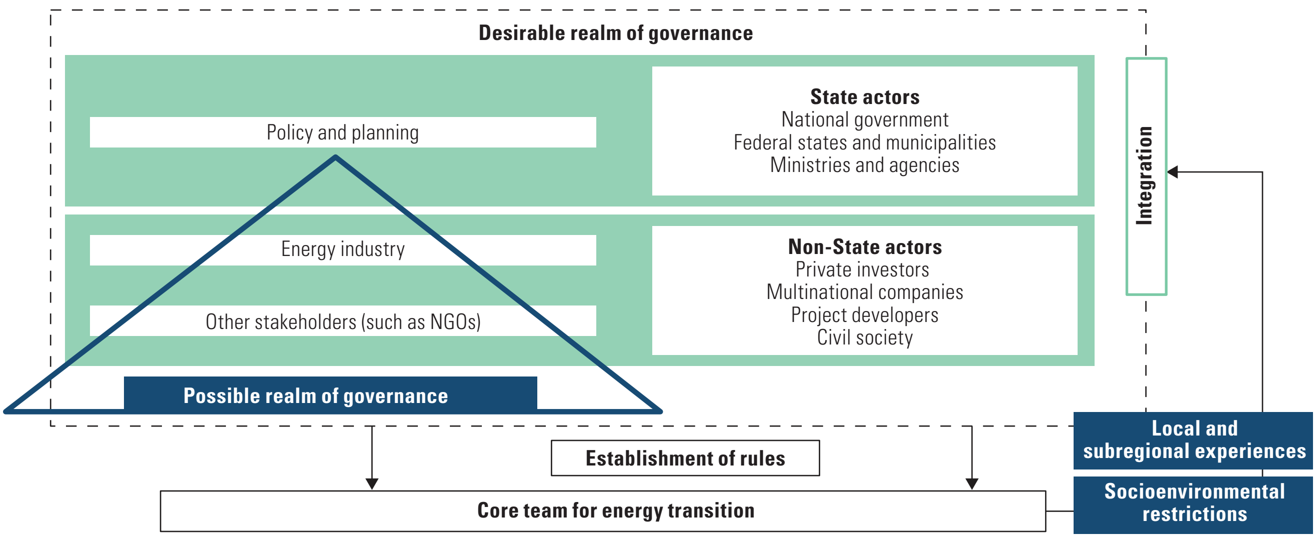
Often, during the implementation of the programmes and projects of a public policy cycle for the transition, only some of the planned stages of the initial proposal are completed. The full plan cannot be put into practice because of various political, social, economic, environmental, regulatory, territorial and other factors. This can be seen in diagram II.3, where the realm of the desirable is reduced to the possible; moreover, even in that context, attention must be paid to interactions between multiple actors, levels of government and the State, all of which must come together under the mandate of the authorities in charge of managing the transition, invariably in accordance with the institutional architecture of country in question.

[13] See information on the United States in Lange, Page and Cummins (2018) and on Indonesia in Marquardt (2014).

In federal countries, for example, renewable energies developed slowly because federal government decisions failed to address the following issues: the need to provide investors with greater certainty by creating fiscal policies that provide long-term incentives (from the design phase through to construction) rather than providing certainty for a short period of time; the need to replace the complex multilevel (federal, state and local) and multi-agency licensing regime with an integrated framework, such as a broader spatial plan with designated areas for project use (solar, wind, micro-hydro and others); and the absence of a system of formal arrangements to promote the energy transition governance through policy integration and implementation, regulation and the participation of national and transnational stakeholders.

The speed of the energy transition will therefore depend on the State's ability and willingness to address the issues and to create the necessary momentum for sustainability and the support needed at the appropriate level. At the same time, the region's governments and civil societies must commit to building a future in which sustainable development is realized through concrete actions, such as ensuring that local communities have access to the benefits and energy services provided by the projects in their territories, and that economic instruments are designed and enforced to accelerate the adoption of renewable energies and generate all the benefits described above in terms of equity, sustainability and greater security and resilience in the face of external shocks.

Diagram II.3
Realms of the desirable and the possible for energy transition governance



Source: Economic Commission for Latin America and the Caribbean (ECLAC).

(c) Two approaches to improve governance and policymaking during the energy transition

(i) The need to adopt an integrated and systemic approach based on shared responsibility

The approach to governance and policy design for the energy sector must be viewed in a broader context, as the sector is a subsystem that meets human and productive needs. Management and public policy problems can occur in situations stemming from global crises, such as climate change, the coronavirus disease (COVID-19) pandemic and the conflict in Ukraine, and such problems are magnified by the influence of the energy sector and its interactions with all other economic and productive sectors and with homes, buildings and public health. Often, inadequate or absent inter-agency coordination creates difficulties for local stakeholders and makes the proper implementation of public policy impossible.

For example, poor management of multiple water uses in a river basin that serves agriculture and the mining industry, runs a hydroelectric power plant and produces drinking water can lead to conflicts which impact all users' needs and productivity, with water draws that can exceed the defined minimum ecological flow of the basin, however it may be defined. Such situations are exacerbated by climate change and the water scarcity faced by most of the region's river basins, and this goes far beyond sectoral energy policy to encompass all macroeconomic, industrial, social infrastructure and environmental policies (see diagram II.3).

Consequently, the actions and policies to be implemented in the energy transition process require a systemic approach and the active participation of all actors engaged in building sustainable development —the executive, legislative and judicial branches of government, their different levels (central, state, provincial and municipal), business representatives, workers, the rest of civil society and the affected communities— since sustainable development is an inescapable shared responsibility in keeping with the democratic system.

Taking into account the different institutional architectures, regulatory frameworks and energy systems in the region's countries and the considerations of a sustainable, fair and inclusive energy transition, ECLAC has proposed the following necessary changes: a broadening of policy objectives; expansion and decentralization of the role of the State, private actors and community organizations; adaptation and updating of new regulatory instruments; and overhauling the active structure in the energy sector and its links with State organization and energy policymaking (OLADE/ECLAC/GTZ, 1997).

As shown in diagram II.3, in a policymaking approach of systemic and shared responsibility, all stakeholders participate, in particular those who are affected (local experiences) or implicated, since the ultimate, overarching objective is to achieve people-centred sustainable and inclusive development. Moreover, its essential domain encompasses not only the tangible realm —the territory— but also the intangible, composed of the conditions, skills and abilities, rights and obligations, and opportunities shared by local communities.

This integrated approach requires coordination among fiscal, economic, social, environmental and energy policy regulatory instruments, and between the regulators charged with enforcing them. That coordination, however, must also be vertical, between the central, regional and local levels; in other words, systemic and integrated management is needed (ECLAC/OLADE/GTZ, 2003).

Consequently, the management of the energy transition must be supported by the following complementary pillars:

- Long-term energy planning, which must be strategic, provide guidelines and pay special attention to evolving beyond the rigidity of the traditional regulatory approach still present in the region's countries. In this way, planning can become a basic tool for establishing a sustainable and inclusive energy policy that is integrated, flexible and feasible. Policy effectiveness must be monitored and verified through quantitative indicators and policy must be based on sectoral forecasting. As a starting point, current energy policies must be redesigned, maintaining all or some of the previous objectives, incorporating aspects related to sustainability and taking account of the entire spectrum of new instruments and actors involved. The State can greatly facilitate the performance of decentralized and private entities by providing an information system and forecasts of sectoral trends.

- Energy integration and complementarity, which are key to the energy transition. The energy sector must contribute to resolving structural problems and deficiencies in order to consolidate the transition through a productive transformation that adds value, innovation and technology to raw materials. Regional integration must therefore be revitalized, and at the same time, infrastructure investment must be stepped up at every link along the energy chain. On this point, CAF and others (2013) states that "integration processes have been developed throughout history [...] following current political, economic and regulatory paradigms. Although some significant results have been achieved, there are still barriers [...]. Perhaps the most important barrier involves the dichotomy between the objectives of self-sufficiency versus the concept of integration [...] and/or countries' energy policies". It concludes as follows: "…planning with a regional vision requires the political commitment of governments and institutions, agreements between countries tailored to the characteristics of each project, and a regulatory framework to facilitate investment and integration processes".

(ii) Energy democracy: an approach based on political power and decentralized energy systems

Energy democracy is a contemporary expression of the use of technological systems for energy production, distribution and consumption in pursuit of social and environmental justice and self-determination. It involves systematically reducing fossil fuels and promoting renewable energy. One of its key tenets is that the energy sector must remain in the public sphere, and that energy system technologies and governance must be restructured to achieve greater democracy and social inclusion in energy generation and consumption and to promote universal coverage for the entire population (Burke and Stephens, 2018; see also REScoop.eu, 2015).

Energy democracy in the context of the energy transition opens up new opportunities and dimensions in the sector, since consumers are replaced with "energy citizens". Above all, energy democracy can help make the energy transition a pathway for the democratization of development (Burke and Stephens, 2018).

Consequently, decentralized energy and distributed generation systems (for example, systems based on solar or wind energy and micro-hydroelectric plants, with production consumed locally) offer more flexibility than more centralized energy systems (those mainly based on fossil fuels), which concentrate energy distribution in centres of political and economic power. Accordingly, new distributed generation energy policies could be adopted to benefit more remote communities, which are generally more vulnerable, more economically disadvantaged and have less political decision-making capacity. In this way, the vision of energy democracy can unify diverse perspectives around a shared strategy for the future of the sector and the role of renewable energy (Burke and Stephens, 2018).

The common denominator of a good energy transition is a national commitment to build and consolidate the capacity of citizens and different communities that will be responsible for defining the so-called "democratic governance of energy". That governance is understood as a shared, democratic space (transparent and with regulations, financing and infrastructure) where decisions are made on issues related to energy quality and renewability and access for all (Burke and Stephens, 2018).

5. Scenarios for the sustainable and inclusive energy transition in Latin America and the Caribbean

Transition energy is a new transformational industry based on innovation and efficiency, which increasingly incorporates renewable and clean sources and contributes to the creation of quality jobs, to innovation and to the creation of new value chains to support the recovery of the region's economies. In order to analyse how the region could advance in the energy transition and the level of investment required, ECLAC proposed three scenarios in 2021, with different assumptions regarding progress with electrification, the adoption of renewable energies and energy integration. Those scenarios were established on the basis of others proposed by ECLAC itself and other international organizations (global and regional).

(a) Worldwide energy consumption forecasts

OLADE has presented the analyses and results of the forecasts of 12 international organizations, 5 of which break down the analysis by sources and sectors as summarized on table II.4, including that of the International Energy Agency (IEA, 2029). On average, between 2017 and 2040, the average annual rate of change in global energy consumption is expected to be 1.03%, meaning that consumption would rise from 14,021 MTOE in 2017 to 17,576 MTOE in 2040. Of the different agencies, Greenpeace forecasts the highest annual rate of change (1.36%), while the World Energy Council (WEC) forecasts the lowest (0.69%) (see table II.4).

Table II.4
Global energy consumption: forecast average annual rate of change, according to various international organizations, 2017–2040
(Percentages)

International Energy Agency (IEA)	United States Energy Information Administration (EIA)	ExxonMobil	Institute of Energy Economics, Japan (IEEJ)	BP	Organization of the Petroleum Exporting Countries (OPEC)
1.08	1.01	0.79	1.21	1.28	1.07
Gas Exporting Countries Forum (GECF)	**World Energy Council (WEC)**	**Massachusetts Institute of Technology (MIT)**	**Energy Research Institute of the Russian Academy of Sciences (ERIRAS)**	**Greenpeace**	**Equinor**
1.04	0.69	0.87	0.95	1.36	0.97

Source: Latin American Energy Organization (OLADE), *Panorama Energético de América Latina y el Caribe 2019*, Quito, 2019, on the basis of International Energy Agency (IEA), *World Energy Outlook 2018*, Paris, 2018; Energy Information Administration (EIA), *International Energy Outlook 2017*, 2017; ExxonMobil, *2019 Outlook for Energy: A Perspective to 2040*, 2019; Institute of Energy Economics, Japan (IEEJ), *IEEJ Outlook 2019*, 2018; BP, *BP Energy Outlook: 2019 edition*, 2019; Organization of the Petroleum Exporting Countries (OPEC), *World Oil Outlook 2040*, 2018; Gas Exporting Countries Forum (GECF), *GECF 2018 Global Gas Outlook Synopsis*, 2018; World Energy Council (WEC), *World Energy Scenarios 2016*, London, 2016; WEC, *World Energy Scenarios 2017*, London, 2017; J. Reilly and others, *Food, Water, Energy, Climate Outlook: Perspectives from 2018*, Massachusetts Institute of Technology (MIT), 2018; Energy Research Institute of the Russian Academy of Sciences (ERIRAS), *Global and Russian Energy Outlook 2016*, Moscow, 2016; Greenpeace, *Energy [r]evolution: A Sustainable World Energy Outlook 2015*, Amsterdam, 2015; Equinor, *Energy Perspectives 2018: Long-term Macro and Market Outlook*, Stavanger, 2018.

The forecasts agree that in 2040, fossil fuels will continue to play a significant role in the global primary energy mix, despite more rapid growth of renewables. The shares of oil and coal are expected to decrease, while those of natural gas and renewable energies are forecast to rise. In 2040, petroleum derivatives will continue to dominate final energy consumption, as they presently do, mainly on account of growth in the transport sector. At the same time, the use of natural gas for final energy consumption is expected to increase gradually until 2040, with transport and electricity generation the main users. The share and volume of coal, which ranked second among the energy products used in 2018, would drop significantly by 2040, as it is forecast to be replaced by natural gas and renewables. In addition, all forecasts indicate that hydropower will continue to grow, albeit at a slower rate than in previous decades (from a 2.5% share of primary energy consumption in the base year to almost 3% in 2040).

The future share of nuclear power in the energy mix will be limited because of the risks of accidents, such as those that occurred at Chernobyl and Fukushima, and because radioactive waste remains a difficult problem to solve. At the same time, the region can closely monitor the global progress of nuclear fusion, which is promising since it does not produce radioactive waste or pollutants and would be an intrinsically safe nuclear technology since it does not involve a chain reaction.

(b) ECLAC scenarios for electricity generation in Latin America and the Caribbean

In 2021, ECLAC established estimates of the complementarity of electricity systems and the use of renewable energies in the region to meet the rising demand for electricity in a clean and sustainable way. As part of that initiative, a study was carried out of the electricity sector in the entire region using the PLEXOS tool.[14] The aim was to demonstrate that the region's energy transition was viable in economic, social and environmental terms through the implementation of renewable technologies, with over 80% of the electricity mix sourced from renewables.

The study proposed three scenarios for the sustainable energy transition:

(i) Baseline scenario. The baseline scenario assumes that renewable energies are adopted according to the long-term expansion plans of the region's countries and OLADE data available as of 2021. The scenario only considers binational interconnections and scant integration of international transmission to meet the regional demand forecast for 2032.

(ii) Scenario with a high share of renewable energy, but scant integration of international transmission. This scenario assumes that a large proportion of the energy generated in the region in 2032 comes from renewable sources; interconnections, however, remain the same as in the baseline scenario.

(iii) Scenario with a high share of renewable energy and high regional transmission integration. This scenario assumes that, by 2032, a large proportion (up to 80%) of the electricity generated in the region comes from renewables, that generation is carried out cost-effectively, and that there is a high degree of international interconnection, in which renewables are extensively integrated.

After analysing the results of the different scenarios, the conclusion is clear: decarbonizing the electricity sector is possible, but it requires a major investment and transition effort to incorporate renewable energies and promote and strengthen regional electricity complementarity initiatives, focusing primarily on making national electricity grids more flexible. This is particularly important since the current system is based on synchronous hydrothermal generation, which is very different from the generation provided by variable renewables such as wind and solar, which were not

[14] The calculations were based on ECLAC and OLADE databases, using the PLEXOS software kindly provided by the Inter-American Development Bank (IDB) and the methodology used in the "Grid of the future" study (Ipakchi and Albuyeh, 2009). PLEXOS Integrated Energy Model is a simulation software package designed by Energy Exemplar to analyse the energy market. Initially it was designed as an electricity market simulator, but later, its functionality was expanded and the latest versions now include electricity, gas, heating and water. See [online] https://www.energyexemplar.com/plexos.

taken into account in designing the original power grids. This is a key point, as the complementarity between those sources, together with hydropower and the potential use of storage in the medium term, is deemed vital for the new sustainable energy system to function correctly.

Table II.5 shows the level of renewable energy adoption, the total investment costs (construction; generation, transmission and distribution infrastructure; and operation and maintenance) and the region's estimated carbon emissions in 2021 in each of the scenarios analysed.

Table II.5
Latin America and the Caribbean: renewable energy adoption, costs and investment requirements, and CO_2 emissions in three regional scenarios, 2018–2032

Scenario	Renewable energy adoption	Investment requirements *(Billions of dollars, at constant 2018 prices)*	CO_2 emissions
Baseline scenario[a]	The share of solar, geothermal, mini-hydro, marine energy and biomass technologies in total electricity generation increases from 12.7% to 24.6%.	852	4 784 929 kt of CO_2e are emitted between 2020 and 2032.
Scenario with a high share of renewable energy	The share of (non-hydro) renewables in total electricity generation rises from 12.7% to 41.1%.	817	Emissions are reduced by 30.1% compared to the baseline scenario.
Scenario with a high share of renewable energy and high regional transmission integration	The share of (non-hydro) renewables in total electricity generation increases from 12.7% to 39.5%, with which 80% of all electricity generated comes from renewable sources.	811	Emissions are reduced by 31.5% compared to the baseline scenario.

Source: Economic Commission for Latin America and the Caribbean (ECLAC).
[a] The baseline scenario was established on the basis of the energy plans of the region's countries for 2018 to 2032.

The results confirm that increasing the share of renewables in the electricity grid demands more baseload dispatchable generation, which in principle, in this case, favours hydropower. Technically, however, variable renewables with storage can be considered to be dispatchable baseload power and can provide ancillary services, such as maintaining the integrity, quality and operational safety of the electricity service. These ancillary services are essential for the operation of an electric power system.

Thus, the main results for the region show that in the high-integration scenario, the adoption of solar and wind technologies is lower than in the non-integrated scenarios because of the system's greater efficiencies and economies of scale and the possibility of reducing the number of new generating plants.

It is estimated that, in the high-integration scenario, the sum of cost of generating electricity (fuel, transmission, operation and maintenance) and the cost of investing in new generating capacity (solar, wind, geothermal and other technologies) will be lower, even though new transmission lines will have to be built. Several of the region's countries could access surplus generation from third countries, so they would not need to build new power plants; however, a high degree of political will and adequate energy planning would be required. It is very likely that in the high-integration scenario, the region's electricity system would be more efficient because losses would be lower and there would be less of a need to establish new generating plants since interconnections would replace them. As a result, greenhouse gas emissions from the region's electricity system would fall. The investments needed for the high-integration scenario would also lead to the development of sustainable electricity infrastructure that would require greater regional interconnection based on renewable energies, creating approximately seven million new green jobs over a ten-year period.[15] Moreover, if the renewables industry were located in Latin America and the Caribbean, the mere fact

[15] Calculation by ECLAC based on the deployment of solar, wind and biomass technologies. The calculations cover construction, installation, operation and maintenance costs for the 2020–2030 period.

of manufacturing the solar panels and wind turbines needed to achieve that scenario would create almost 1 million new jobs for the region.[16]

A highly relevant public policy recommendation arises from these scenarios, one that has already been set out in this document: that the equivalent of 1.3% of annual GDP be invested in Latin America and the Caribbean over the next ten years. That level of investment would enable progress towards universal access to renewably sourced electricity, a large share of renewables in the regional mix, increased energy integration and a 31.5% reduction in CO_2 emissions.

The abundant renewable sources in the region and their complementarity offer a splendid opportunity to develop a common regional electricity market and move towards regional integration. Integration could create opportunities for development, as it would make the system more efficient, enable economies of scale, and maximize flexibility for the adoption and combination of renewable sources and for the distribution of the resulting electricity. At the same time and considering the growing electrification of the transport and industrial sectors, integration would also support those new trends. In addition, natural gas infrastructure and the potential of renewable sources in the region could boost the production and exchange of green hydrogen. Despite this encouraging scenario, the absence of political agreements and historical mistrust constrain the exploitation of the region's potential.

Although the current cost of large-scale renewable energy storage increases the costs associated with those energy sources to some extent, it is expected that costs will continue to fall, encouraging the greater integration of renewable energies in the short and medium terms. Integration could even resolve intermittent, localized transmission infrastructure deficits, because if clean energy is stored, its injection into the grid systems can be postponed.

Given the uneven size and distribution of the region's energy resources, it will be more costly and complex for many countries to meet the challenges posed by rising electricity demand over the coming decades, particularly in light of the trend-breaking increase resulting from the electrification of the transport sector and increased industrial use. Likewise, the uneven landscape makes it necessary to conduct subregional analyses and to evaluate Brazil and Mexico individually, given the heft of those countries in the region's energy sector.

Finally, it should be noted that given the geography of the Caribbean, which prevents the implementation of terrestrial electrical interconnections, that region's countries were not included in the ECLAC study.[17] Therefore, the future opportunities and investment costs of pursuing submarine cable electricity integration fed by geothermal power should be explored, as done in Koon Koon and others (2020) for Saint Lucia, Saint Vincent and the Grenadines, Saint Kitts and Nevis, and Dominica, and the benefits of distributed solar and wind generation should be maximized.

C. Conclusions

ECLAC is vigorously promoting an energy transition for Latin America and the Caribbean that can contribute substantially to the 2030 Agenda and the achievement of the SDGs, with special emphasis on the three main targets of SDG 7. The transition implies a profound change that universalizes access to energy services, increases electrification,

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16 Calculation by ECLAC on the basis of manufacturing related to solar and wind technology.

17 A Nexant study (2011) estimated that interconnecting nine countries in the Caribbean region, using submarine cable interconnections and renewable sources, would cost around US$ 30 billion. The countries covered in the study were Saint Lucia, Saint Vincent and the Grenadines, Grenada, Antigua and Barbuda, Saint Kitts and Nevis, Dominica, Haiti, the Dominican Republic and Jamaica.

and addresses the need to decarbonize by incorporating renewable sources in a new energy system that is sustainable, fair, efficient, safer and more resilient to external shocks.

The energy transition is a process whereby the energy system is transformed in a sustainable fashion through the introduction of innovative public policies, the adaptation of institutions, and the establishment and implementation of new regulations that allow for increased investment in renewable energies and related industries and infrastructure. It would accelerate technology adaptation for renewables and increase the efficiency of all productive sectors and the residential and building sectors. Simultaneously, since natural resources are available throughout the region, energy security can be boosted through complementarity and energy integration, reducing the vulnerability of energy to external shocks. A nurturing ecosystem with better governance and institutions must be built, together with interconnected regulatory frameworks, to drive the necessary investment and unlock financing, accelerating national energy transitions in all the region's countries.

The global use of renewable energy sources has experienced a period of great expansion, in terms of both installed capacity and energy output, and this has also occurred in the region with the prevalence of biomass, solar and wind energy. The cost of solar and wind power, already fully competitive with fossil fuel-based power in the region, continues to fall, as does the cost of batteries.

However, the sharp reduction in the cost of renewables and storage technologies will not be enough without effective governance, modern regulatory frameworks and long-term national energy planning to improve service quality and boost energy security in the face of external shocks.

Energy integration yields numerous benefits in terms of energy security, investment savings and greater infrastructure efficiency. Pipeline networks connecting different countries, most densely in South America, can be converted to transport green hydrogen at a much lower cost than building new pipelines. ECLAC estimates show that if the equivalent of 1.3% of GDP were invested over a period of ten years (US$ 811 billion), an electricity generation mix with high renewable content would be achieved, progress towards universal access would be made, 7 million green jobs would be created and GHG emissions would be reduced by 31.5%. Depending on the productive structure, the energy mix, technology and the relative local costs of solar, wind and biomass energy, countries will require more or less investment than the weighted regional average amount.

In recent years, solar and wind energy and batteries have entered the region's energy markets and are consolidating their position, demonstrating that they are competitive and profitable compared to fossil fuels. The next stage is to maintain quality, integrity and operational safety with new and improved storage systems, and to make further progress with new developments, such as green hydrogen, which is already being produced in pilot and demonstration projects.

Eliminating fossil fuel subsidies, and ideally, taxing carbon emissions would discourage the use of that kind of fuel, and this, coupled with the significant reduction in the cost of electricity from renewables, would create very competitive market conditions for clean energy and its storage, including green hydrogen. Financing mechanisms that reduce investor risk are also essential, and the capacity to design bankable and scalable projects in a competitive and dynamic financial environment for the sector must be improved.

Finally, in order to accelerate national energy transitions, ECLAC proposes that countries implement public policies such as boosting investments (particularly in transmission and distribution infrastructure), increasing the renewable content of the energy mix, improving efficiency in all productive sectors and buildings, and ensuring universal access to energy services.

The energy transition is a driver for a transformative economic recovery that can redesign development models in Latin American and Caribbean countries by promoting renewable energy value chains and the associated new industries, generating more value added, retaining it locally, and creating green jobs. Given the completely cross-cutting nature of energy as a driving force for the productive transformation that the countries of Latin America and the Caribbean require, it is essential that policies and plans for the development of renewable energy progressively incorporate the entire value chain of renewable energy and energy efficiency products and services, and that these processes are interconnected with industrial, productive and social policies.

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CHAPTER

III

Towards a sustainable and inclusive water transition in Latin America and the Caribbean

Introduction

A. Water management challenges in Latin America and the Caribbean

B. Towards a sustainable and inclusive water transition in Latin America and the Caribbean: recommendations for governance and public policy guidelines

C. Conclusions

Bibliography

Introduction

Unequal access to water in Latin America and the Caribbean has been persistent in recent decades and precarious coverage means that millions of people still lack safely managed water and sanitation. Overexploitation of water resources is rising and pollution of water bodies is increasing. This is further complicated by the current context of progressive climate instability, extreme events, including hurricanes, floods and droughts, and their effects, as well as external shocks like the pandemic and geopolitical conflicts, such as the conflict in Ukraine and its repercussions. Moreover, the cascading crises endured in the region and described in chapter I (namely the pandemic, inflation, rising poverty, low economic growth and fiscal constraints) mean that it will be difficult to achieve Sustainable Development Goal (SDG) 6 and its targets by 2030. As a result, the countries and territories of Central America and Mexico, the Caribbean, and South America face urgent socioeconomic, health and environmental challenges in managing water resource supply and demand in a fair and sustainable manner.

In 2023, the region as a whole is either making very slow progress towards achieving the targets of SDG 6 by 2030 or is even losing ground.[1] At the regional level, progress has been made —albeit very slowly— towards targets 6.1 and 6.2 on universal access to water and sanitation as human rights. The same is true for target 6.3 on improving water quality and reducing pollution in bodies of water and their ecosystems and for target 6.5 on integrated water resource management. Of greatest concern is the outlook for targets 6.4, on water-use efficiency, and 6.6, on protecting and restoring water-related ecosystems, since setbacks have been reported in that regard, a trend that is likely to continue.

This means that the region's countries must take urgent and resolute action to find a path towards the achievement of the targets of SDG 6 by 2030. Those actions are included in the recommendations of ECLAC for an inclusive and sustainable water transition, in line with the Regional Water Action Agenda agreed at the Regional Water Dialogues in February 2023 and presented at the United Nations Water Conference in March of that year.

It is critical to reclaim the central role of water in the economy, health and climate. Water cuts across the Goals of the 2030 Agenda for Sustainable Development. However, our society seriously minimizes its value, equating it merely with market price while at the same time marginalizing this invaluable asset to the point of seeing it as a simple externality (Corry, 2022). Although water is literally vital and is not a typical economic good, it is an irreplaceable input for agriculture, hydropower, mining, tourism and ecosystem services, hence the urgency of moving towards a more sustainable and inclusive transition in water management.

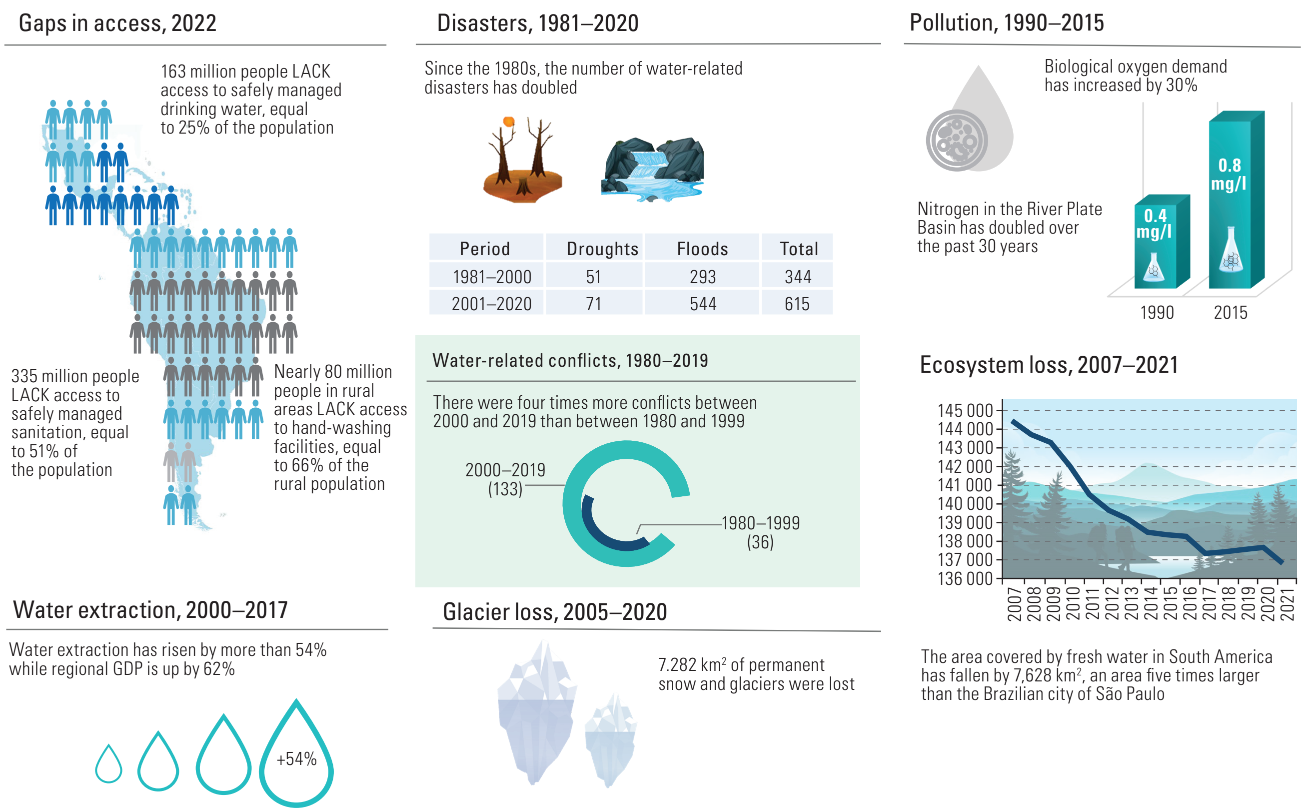
It is therefore necessary to review the current multi-stakeholder governance systems and public policies in order to work for a transition in regional water management that will allow for universal access to safe drinking water and quality sanitation and promote responsible and sustainable water use based on circularity and equity. The main advances and challenges are discussed below, and some recommendations for water management are put forward. The analysis covers issues from watersheds to sectoral uses and addresses water availability and conservation, efficient water use and the various ways in which this resource can be reused.

[1] ECLAC (2023a) provides a comprehensive analysis of the region's progress and challenges in relation to SDG 6 and other SDGs at the halfway point to 2030.

A. Water management challenges in Latin America and the Caribbean

Managing water resources requires simultaneously addressing several considerations and promoting the active participation of multiple stakeholders who play different roles. Managing water, sanitation, the water cycle and water-based ecosystems entails a number of challenges that have become more acute in the context of the effects of climate change (see image III.1).

Image III.1
Latin America and the Caribbean: evolution of water challenges in recent decades, 1980–2022



Source: Prepared by the authors, on the basis of World Health Organization/United Nations Children's Fund (WHO/UNICEF), WHO/UNICEF Joint Monitoring Programme (JMP) Database [online] https://washdata.org/data; Food and Agriculture Organization of the United Nations (FAO), AQUASTAT [online database] https://www.fao.org/aquastat/en/databases; Institute of Environmental Science and Technology of the Autonomous University of Barcelona (ICTA-UAB), Environmental Justice Atlas [online database] https://ejatlas.org/commodity/water; United Nations Environment Programme (UNEP), GEMStat Data Portal [online database] https://gemstat.org/data/data-portal/; Centre for Research on the Epidemiology of Disasters (CRED), International Disaster Database (EM-DAT) [online] https://www.emdat.be/database; Economic Commission for Latin America and the Caribbean (ECLAC), *A decade of action for a change of era* (LC/FDS.5/3), Santiago, 2022.

The ten main challenges facing the region can be summarized as follows:

(i) A significant deficit in the coverage of safely managed water and sanitation: millions of people are being left behind in the human right to water and sanitation.

(ii) Inequity persists in the world's most unequal region as regards access to drinking water and sanitation services and the quality with which they are delivered. At the same time, the fees charged are regressive.

(iii) The network infrastructure is inadequate and dilapidated and significant amounts of water are wasted.

(iv) Water is unevenly distributed across territories, and water stress is high (high extraction compared with the water available in the territory), especially in large cities and areas with high levels of economic activity.

(v) Water governance is complex, as it involves multiple actors and levels of government, and national authorities lack the required hierarchical status because they are not at the ministerial level.

(vi) Conflicts among different uses and users along watercourses are increasingly common; at the same time, there are negative externalities associated with overexploitation.

(vii) The ever-increasing impacts of climate change and water-related disasters, such as storms, floods and droughts, are harming human settlements and ecosystems and decreasing the availability of safely managed water.

(viii) Pollution of surface and coastal watercourses and bodies of water is on the rise and there is relatively little sewage treatment.

(ix) Sectoral and household water use is inefficient (efficiency is below the global average) and water extraction has not been decoupled from the creation of value added.

(x) There is not enough quantitative information for making decisions and targeting investments.

The cascading crises in the Latin American and Caribbean region —reflected in inflation, slow economic and employment growth and rising poverty and vulnerability— increase the gravity and scope of most of these challenges.

1. The human right to safe drinking water and sanitation

The General Assembly of the United Nations recognized the human right to safe drinking water and sanitation in 2010, and that recognition has since been enshrined in the constitutions of many of the region's countries. However, while the region has made significant progress in basic coverage for both services in recent years, sizeable gaps remain.

With the adoption of the 2030 Agenda, the challenge of providing safely managed water supplies and sanitation services was assumed in order to achieve better quality standards in safety, accessibility, continuity, healthiness and so on;[2] at the same time, a challenge emerged with regard to measuring compliance with those standards through the corresponding indicators.[3] In 2022, more than 25% of the population of Latin America and the Caribbean (163 million people) lacked access to safely managed drinking water, compared to a much lower rate of 6% in Europe and North America. Similarly, 51% of the region's population (335 million people) lacked access to safely managed sanitation, compared to an estimated 16% in Europe and North America (see table III.1). Rural areas remain the most disadvantaged and, unlike cities, are far from having high coverage rates of safely managed services (see figure III.1).

[2] Safely managed drinking water is water for consumption from an improved source that is located within the home or in the home's yard or plot, is available when needed, and is free of faecal contamination and priority chemical contamination. Safely managed sanitation entails improved facilities that are not shared with other dwellings and where the excreta are safely treated *in situ* or transported to another location (WHO/UNICEF, 2019).

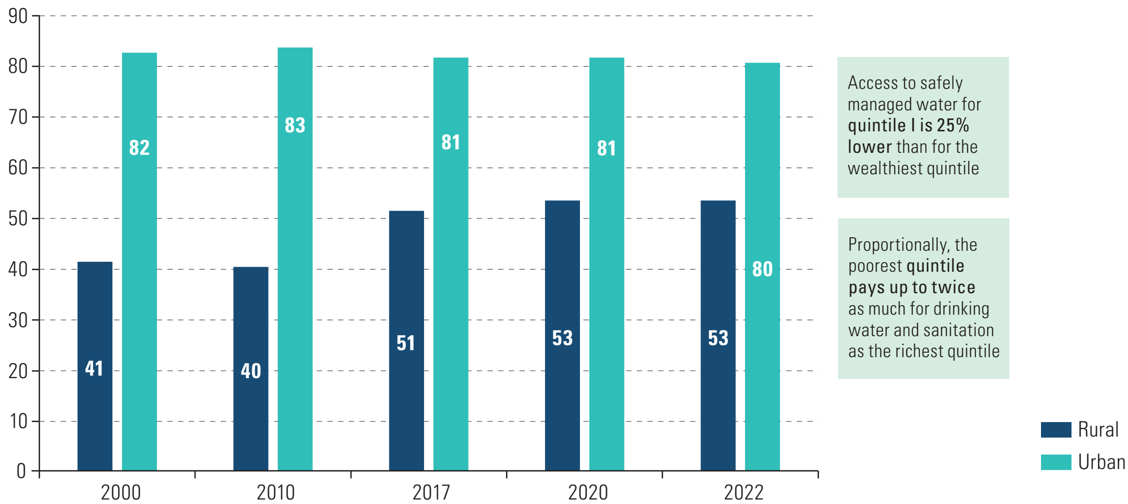
[3] SDG indicators 6.1.1 and 6.2.1 cover water supply and sanitation.

Table III.1
Latin America and the Caribbean: coverage of safely managed drinking water and sanitation services and population with access, 2000–2020
(Percentages and millions of people)

	Safely managed drinking water					Safely managed sanitation				
	National coverage *(Percentages)*	Urban coverage *(Percentages)*	Rural coverage *(Percentages)*	Population with access *(Millions)*	Population without access *(Millions)*	National coverage *(Percentages)*	Urban coverage *(Percentages)*	Rural coverage *(Percentages)*	Population with access *(Millions)*	Population without access *(Millions)*
2000	71.7	81.8	40.8	374	147	15.2	19.4		79	443
2010	74.7	82.7	45.4	441	150	22.6	27.5		134	457
2017	75.3	81.3	50.7	479	157	30.3	35.7		193	443
2020	75.4	80.6	53.1	493	161	34.1	39.6		223	431

Source: Prepared by the authors, on the basis of World Health Organization/United Nations Children's Fund (WHO/UNICEF), WHO/UNICEF Joint Monitoring Programme (JMP) Database [online] https://washdata.org/data.

Figure III.1
Latin America and the Caribbean: access to safely managed drinking water in rural and urban areas, 2000–2022
(Percentages)



Source: Prepared by the authors, on the basis of World Health Organization/United Nations Children's Fund (WHO/UNICEF), WHO/UNICEF Joint Monitoring Programme (JMP) Database [online] https://washdata.org/data.

The region has a wide range of different organizational models for the provision of drinking water and sanitation services, and in this regard, a distinction must be drawn between urban and rural areas (Fernández, Saravia Matus and Gil, 2021). Formal providers are found in towns and cities, while in rural areas, low population density and other factors hinder the viability of solutions based on centralized delivery systems capable of recovering their costs. In the region's rural areas, there are hundreds or thousands of community water providers that, under different names (for example, water committees, user associations, cooperatives and others), are responsible for collecting and distributing water.[4] In many cases, these services are provided in informal and rather precarious ways, without treatment, and households are left with the responsibility of managing their own wastewater. In contrast, cities are largely served by formally organized providers. In most cases, the main supplier is a public entity, although there are exceptions. In Chile, private providers predominate in urban areas, while in the Plurinational State of Bolivia, community-organized providers are the dominant model.

[4] In Latin America, 456 million people receive safely managed water services, and 80 million of them, mostly in rural areas, are served by some 80,000 community water and sanitation organizations (OLAS, 2019).

2. Inequality and regressivity in access to water and sanitation

The coverage gaps in rural areas, particularly for sanitation services, reflect income inequality and a limited capacity for infrastructure investments. These inequalities, in turn, amplify the health and well-being problems of the most vulnerable sectors of society. Hence, access to drinking water and sanitation is considered a human right that has direct consequences on citizens' health, food security and well-being. In the region, Peru, Mexico and Chile have invested and advanced the most in safely managed sanitation coverage, achieving increases of 42%, 39% and 28% respectively since 2000 (WHO/UNICEF, 2020). In contrast, in Haiti, only 28% of the poorest population quintile had access to basic drinking water services in 2017, while the national average was almost twice as high. That same year, in Nicaragua, less than 51% of the poorest population quintile had access, while the national average was around 80% (WHO/UNICEF, 2019). Differences in access are also found in large cities, especially those that have undergone rapid urbanization. In 2016, the region's highest mortality rate attributable to exposure to unsafe water, sanitation and hygiene services (SDG indicator 3.9.2) was in Haiti, at 24 deaths per 100,000, followed by Guatemala (6.3), the Plurinational State of Bolivia (5.6), Honduras and Guyana (3.6), and Nicaragua and the Dominican Republic (2.2) (WHO, 2019). Similar inequalities also became evident during the pandemic, when the groups most exposed to contagion were those who lacked the safe water and sanitation facilities needed for frequent hand-washing and a higher standard of hygiene in their homes or workplaces.[5]

Social inequality also worsened owing to the fall in employment caused by the cascading crises described above, which in turn hampered households' ability to pay for basic services. In order to leave no one behind, efforts should be made to ensure that the fees for water and sanitation services paid by the most vulnerable households are not disproportionate to their incomes. The applicable level that has been agreed upon and accepted worldwide is between 3% and 5% of household spending (Ferro and Lentini, 2013; UNDP, 2006). In Latin America and the Caribbean, the share of household spending allocated to drinking water and sanitation services is around 1% in most countries, with an average in urban areas of 0.8%.[6]

Structural inequity and regressivity in the region extend to water access. A higher share of the spending of the most vulnerable quintiles goes to drinking water and sanitation services, with those proportions decreasing among the richer quintiles. Moreover, the first quintile (the poorest) has 25% less access to safely managed water than the richest quintile and pays up to twice as much as a share of income. In addition, higher-income households consume more water in absolute terms: the two richest population quintiles account for almost 50% of the region's total water consumption.

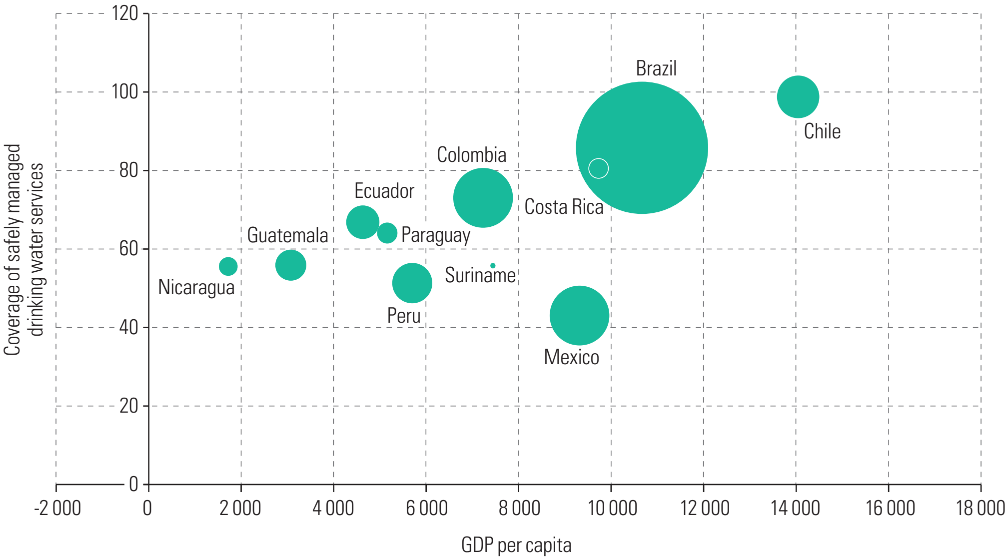
Given that the share of income spent on water in Latin America and the Caribbean is far from the global benchmark (3% to 5%) and the inequality between different income strata, more attention should be paid to relative comparisons, between both quintiles and different countries. Roaf, Khalfan and Langford (2008) suggest that lower-income households should not pay more than three times the average spent on drinking water and sanitation. At the same time, there is room to increase the proportional cost borne by the more affluent segments. A comparison of the countries where the proportion of spending is higher than the regional average shows that in Chile, the two poorest

[5] Millions of people in the cities of Latin America and the Caribbean do not have adequate access to hand washing facilities (WHO/UNICEF, 2020). Vulnerability rates are higher in rural areas, given the inadequacy of infrastructure for both drinking water and sanitation and for health care.

[6] Data from the latest income and expenditure surveys available for 18 Latin American and Caribbean countries.

quintiles can pay up to three times more than the regional average, while in Uruguay, they can pay 2.5 times more. In Costa Rica, the most vulnerable quintile pays twice the regional average and, in Brazil, just over 1.5 times more. However, compared to the national average, the poorest quintile in Chile and Uruguay have to pay nearly twice as much to purchase or access water. Similarly, inequalities in access to safely managed drinking water services are also evident among the region's countries, and those inequalities are directly related to per capita gross domestic product (GDP). In 2020, Chile, Brazil and Costa Rica were the countries with the highest coverage of safely managed drinking water in the region (99%, 86% and 80.5%, respectively) and they were also the countries with the highest per capita GDPs (see figure III.2).

Figure III.2
Latin America and the Caribbean (11 countries): coverage of safely managed drinking water service and per capita GDP, 2020
(Percentages and dollars)



Source: Prepared by the authors, on the basis of World Health Organization/United Nations Children's Fund (WHO/UNICEF), WHO/UNICEF Joint Monitoring Programme (JMP) Database [online] https://washdata.org/data; Economic Commission for Latin America and the Caribbean (ECLAC), *A decade of action for a change of era* (LC/FDS.5/3), Santiago, 2022.

Note: Shows annual per capita GDP at constant 2010 prices. The size of the circles indicates the size of the population with access to safely managed drinking water.

The lack of access to drinking water and sanitation is a barrier to gender equality, and four main gaps can be seen in the region in that regard (Saravia Matus and others, 2022a). The first gap involves the lack of access to water and sanitation infrastructure and the differentiated negative effects this has on women's health and education. The lack of adequate sanitation facilities exposes women and girls to disease and security risks by making them vulnerable to harassment, assault, violence and rape, at school, at work or in the community (UN Women, 2018). The second gap involves access to water for agricultural use, which increases the food insecurity of women farmers. Access to water for such purposes generally goes hand in hand with access to land, and in Latin America and the Caribbean the proportion of agricultural land in the hands of women is below 31%, which means that men control 69% (Nobre and others, 2017). In Central America, women own barely 15% of the agricultural units, while in both the Caribbean and South America, the corresponding percentage is 23% (ECLAC, 2021). The third gap arises from the fact that, without access to water, women have less time for economic activities, since fetching water affects their time use and job opportunities: in Latin America and the Caribbean, women perform an average of 2.8 hours of unpaid work in the home for every hour of unpaid work by men (ECLAC, 2023c). The fourth gap has to do with governance and participation, and it can be seen in the fact that women's participation in community water committees is low, and that they are generally underrepresented at all levels of water governance (Saravia Matus and others, 2022a).

3. Spatial inequality of water availability in a time of climate change

In Latin America and the Caribbean, the per capita water endowment is four times higher than the world average, but the spatial distribution of reserves and flows is uneven. Despite the fact that the region accounts for one third of the world's renewable freshwater resources, availability is uneven from one territory to the next and most are located in rural areas and large river basins. Meanwhile, growing urban areas located in arid or semi-desert areas (such as Lima and Santiago) or at high altitudes, where the water catchment area is lower (such as Bogotá, Mexico City and Quito), face greater challenges as regards stable access to water. The same is true for the small island States of the Caribbean. In all cases, climate change and the impact of disasters (such as storms, droughts and floods) increase instability, damage water infrastructure, hinder productive processes and impede stable access to water and sanitation.

The increasing pressure on water is evident in the level of relative water scarcity or water stress.[7] Although the average stress rate in Latin America and the Caribbean is relatively low (3.5%), it can reach 19% in the Caribbean subregion. It is noteworthy that seven Caribbean countries are among the world's most water-stressed nations, with less than 1,000 m^3 of fresh water per capita (IPCC, 2021). At the national level, water stress varies widely across Latin America and the Caribbean: it is very high in Barbados (87.5%) and Saint Kitts and Nevis (51.3%), islands with little rainfall catchment area, while it is very low in Panama and the Plurinational State of Bolivia, at 0.8% and 1.2%, respectively (see map III.1.A).

Water availability is also highly unequal between the territories of the region's nations: basins and areas where water stress is high can be clearly seen in the most populated areas, where there are also high concentrations of economic activity, and in the most arid or desert areas. The areas with the highest water stress include the small island States of the Caribbean, northern and central Chile, the Cuyo region in Argentina, the coasts of Peru and southern Ecuador, the Cauca and Magdalena valleys in Colombia, the Bolivian altiplano, north-eastern Brazil, the Pacific coast of Central America and much of northern Mexico (FAO, 2016). The stress levels of those areas exceed 80% for periods of between 3 and 12 months per year, which is considered extremely high (Mekonnen and others, 2015) (see map III.1.B).

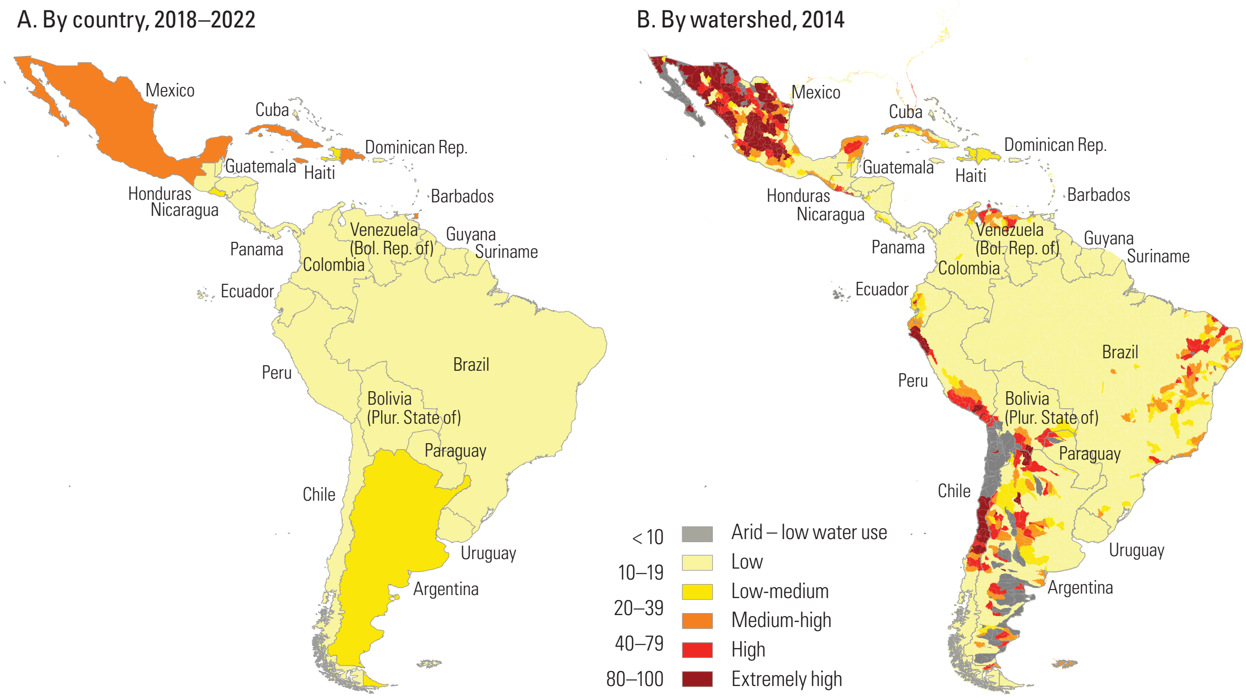
As regards seasonal variations, there are no notable differences during the driest months of the year between the most densely populated areas of Latin America and the Caribbean and other regions known for their high water stress (500 m^3/person/year), such as North Africa and the Middle East (IIASA/WDL, 2019).[8] In the driest months, the region has recorded averages approaching that threshold, which is equivalent to 1.37 m^3 or 1,370 L of available water per person per day. Assuming that one litre of water is required to produce one calorie of food (IWMI, 2007), the anthropogenic pressure is very high under such conditions, since the country's water resources would not even meet the daily nutritional needs of the population.[9]

7 Water stress is measured as the ratio between the total water withdrawn for use by all sectors of the economy and domestic use, and the availability of renewable water resources in each territory after environmental flow requirements have been subtracted (FAO/UN-Water, 2018). Higher indicator values mean greater water stress.

8 Resolutions of more than 15,000 inhabitants per km^2 are used in the analysis.

9 According to WHO recommendations, adult males should receive a caloric intake of between 2,000 and 2,500 kcal/day and adult females between 1,500 and 2,000.

Map III.1
Latin America and the Caribbean: water scarcity stress, by country and watershed, latest available year
(Percentages)



Source: Prepared by the authors, on the basis of United Nations, SDG Indicators Database [online] https://unstats.un.org/sdgs/dataportal/database; World Resources Institute/Utrecht University (WRI/UU), "Aqueduct Baseline Water Stress" [online database] https://resourcewatch.org/data/explore/wat050-Aqueduct-Baseline-Water-Stress.

Note: The values shown on map B are 2014 estimates from a model obtained by performing a regression of water stress conditions over the period 1960–2014.

Rainfall in 2020 was below normal in most of Latin America's tropical areas, while the Pacific coast of Central America recorded more rainfall than normal (IPCC, 2021). Climate projections for 2050 and 2070 associated with rising average temperatures indicate rising rainfall trends in the western Amazon and the southern portion of South America, where precipitation is expected to increase by between 10% and 15% (Magrin and others, 2014). At the same time, droughts are expected in north-eastern Brazil, Mexico, Central America and the Caribbean, where rainfall is expected to drop by up to 20% (Bárcena and others, 2018). Consequently, some areas and basins may have more water available than in the past, while others may experience the opposite and face much longer periods of acute shortages.

Moreover, the frequency of water-related disasters has doubled over the past four decades and the region's rainfall patterns are increasingly unstable, creating a more complex scenario for water management. Latin America and the Caribbean is one of the regions of the world most affected by climate-related disasters (IPCC, 2021) and water trends. Because of rising temperatures and the concentration of atmospheric moisture, hydro-meteorological phenomena such as floods, storms, droughts and heat waves account for 93% of all the disasters in the world over the past 20 years. Although the region contributed only 10% to global greenhouse gas emissions in 2019 (IPCC, 2023), it is disproportionately affected by disasters and their impact. Between 1990 and 2020, 87% of the disasters in the region were linked to water and climate change, affecting increasing numbers of people, housing units and infrastructure assets, including those used for water-related services.[10] Moreover, between 1970 and 2021, disasters

[10] Disasters linked to water and climate change include meteorological, hydrological and climatological disasters, but exclude geological ones (ECLAC, 2022; CRED, 2023).

associated with water and climate change accounted for 77% of the region's reported economic cost, while in the Caribbean that same rate exceeded 90% (ECLAC, 2022). The growing impact of disasters can also be seen in the number of people affected, which has risen to 205 million (and 320,000 deaths) over the past three decades. It should be noted that the number of people killed has decreased considerably over the last eight years, possibly because of improvements in the management of disaster-related risks and emergencies.

At the same time, there has been a significant decrease in the area covered by permanent snow and glaciers in the region: several have disappeared completely, such as the Ventorrillo glacier in Mexico and the Chacaltaya glacier in the Plurinational State of Bolivia (WGMS, 2022). At the southern extreme of the Andes, glacier mass loss stands at about 22.9 gigatons per year (Dussaillant and others, 2019), equal to 9 million Olympic swimming pools.[11] This widespread loss of glacier mass and thawing of permafrost will continue in the Andes under all climate scenarios, leading to significant reductions in river flow and possible flash flooding of large glacial lakes (IPCC, 2021). It should be noted that in most of the region, glaciers have no legal status and are not specifically protected; the exception is Argentina, the first country in the world to enact laws to protect its glaciers.[12]

Another important characteristic of the region's hydrographic systems is the many bodies of water spanning two or more countries, which account for as much as 70% of the surface flow in Latin America and the Caribbean (Peña, Solanes and Jouravlev, 2019).[13] Thus, there are 38 shared river basins, 14 shared aquifers and five shared lake basins in South America. Central America and the Caribbean have 33 shared rivers and lake basins and at least eight shared aquifers (UNEP, 2016a and 2016b). In most cases there are no agreements between the countries on their transboundary water resources, which complicates their management.[14] Another factor that can threaten the proper balance between water availability and demand is the common practice of managing surface water and groundwater in a way that treats them as largely independent (Peña, Solanes and Jouravlev, 2019). This leads to cases in which groundwater extraction wells affect the water reserves of springs, streams and rivers; in addition, since oversight is difficult and limited, clandestine water extraction sites proliferate (Peña, Solanes and Jouravlev, 2019).

4. Competition and conflicts arising from multiple water uses

Over the course of the water cycle, water is used for human needs, economic activities and ecosystem dynamics, and these uses may compete with each other, especially in contexts of relative scarcity or pollution. Water has consumptive uses, which involve extraction and consumption, and non-consumptive uses, in which it is used in its natural environment and thus remains in rivers, lakes or aquifers or is returned to them. Non-consumptive uses, which are those not accounted for in freshwater withdrawal

11 An Olympic swimming pool contains 2,500 m^3 of water. Each cubic metre weighs one metric ton, and 1 gigaton (Gt) is equivalent to 1×10^9 metric tons [t].

12 Glaciers in the Los Nevados National Park in Colombia, the Sierra Nevada National Park in the Bolivarian Republic of Venezuela and the Huascarán National Park in Peru are indirectly protected by means of the protected areas system (IUCN, 2006). Chile has had a Monitoring Unit, a Glaciology and Snow Unit (UGN) and a national glacier strategy since 2009 (DGA, 2016).

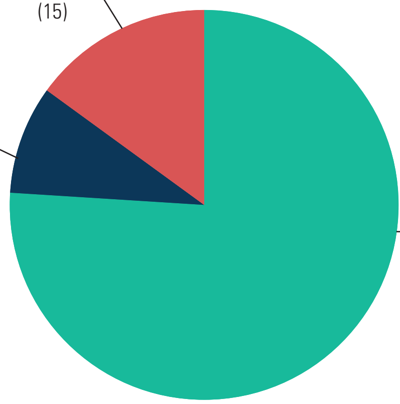
13 Transboundary rivers, lakes and aquifers are found in 22 of the region's 33 countries.

14 According to the preliminary results of the 2017–2018 monitoring of SDG indicator 6.5.2 on integrated water resource management, the overall value of the indicator is relatively low in Latin America and the Caribbean. Thus, in that period, operational arrangements for water cooperation existed for only 24% of the transboundary watershed area in the reporting countries (29% for rivers and lakes and 11% for aquifers) (UNECE/UNESCO, 2018).

statistics, also include productive uses (such as hydropower generation) and uses considered non-productive from an economic standpoint (such as ecosystem integrity, biodiversity, and recreation and culture).

In Latin America and the Caribbean, water extracted for consumptive use serves one of three main purposes: agricultural (76% of the total), municipal (15%) and industrial (9%) (see figure III.3). Municipal use covers water distributed to households and buildings. These proportions are very similar to global averages.

Figure III.3
Latin America and the Caribbean: consumptive uses of extracted water, 2022
(Percentages)



Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), AQUASTAT [online database] https://www.fao.org/aquastat/en/databases/.

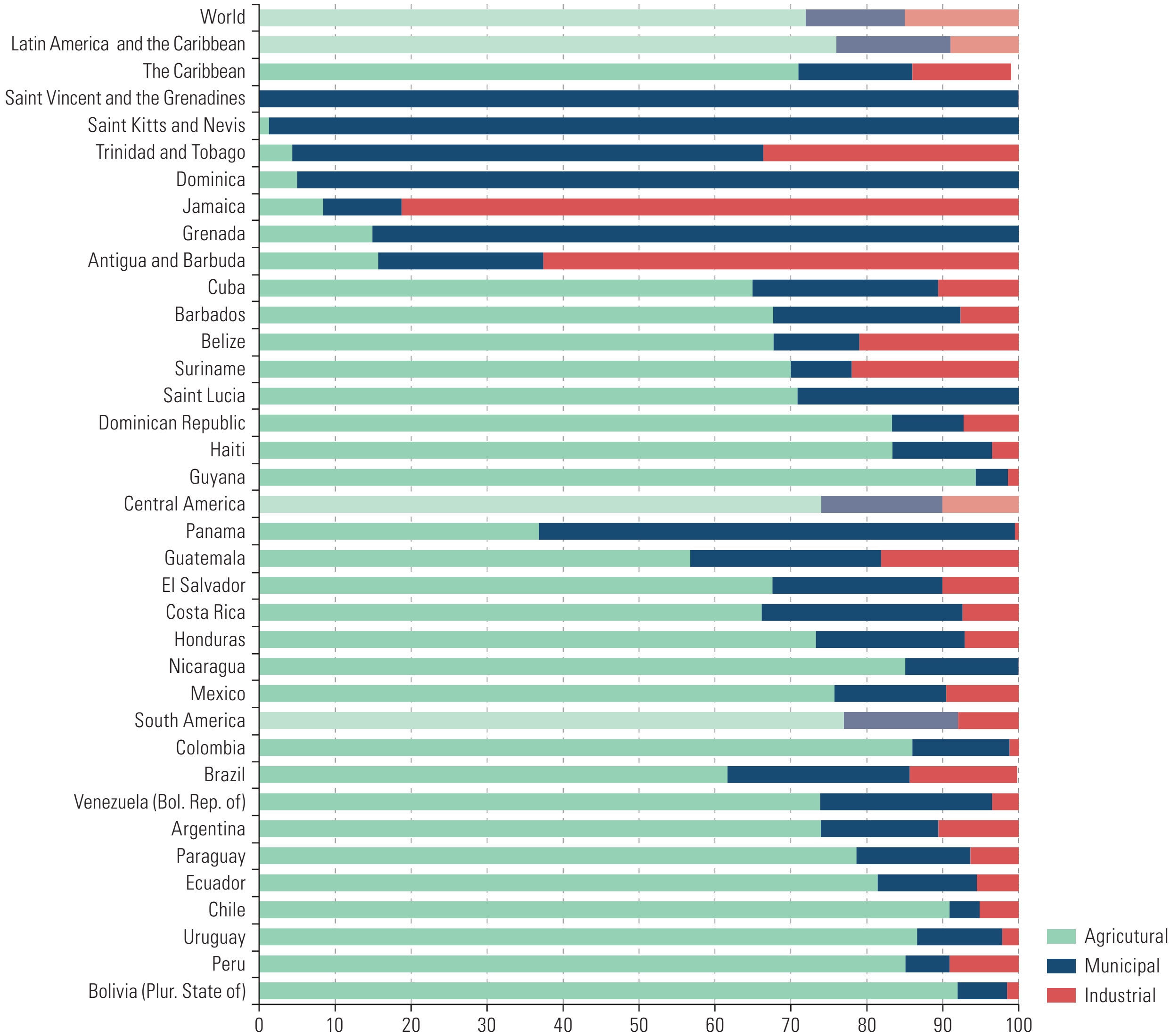
However, the proportion of water extracted for different consumptive uses varies greatly across the countries and subregions of Latin America and the Caribbean (see figure III.4).

In the regulations governing extraction, once concessions or rights have been granted, the cost of using water is usually insignificant in the cost structure of the hydroelectric, mining and agricultural companies (especially large-scale ones), to the extent that it does not even appear on companies' balance sheets (Embid and Martín, 2018). This constitutes an implicit subsidy that reflects neither the strategic value of water in productive processes nor its value when it is scarce. At the same time, negative externalities arise, including the following: in the agricultural sector, insufficient wastewater treatment (and the resulting pollution), overexploitation of aquifers, nitrate contamination and salinization associated with irrigation;[15] in the mining and hydroelectric sectors, conflicts over water use and insufficient pollution control; and in general, loss and degradation of water-related ecosystems (Peña, 2016; Dourojeanni, 2019).

The number of water-related conflicts in the region is rising, and it has been estimated that four times more conflicts arose between 2000 and 2019 than between 1980 and 1999 (ICTA-UAB, 2019). Mexico and South America report the highest number of water-related conflicts. These incidents generally involve private or public companies from the energy, mining and oil sectors, as well as local, regional or national government agencies, international financial institutions and communities. The outcomes of these conflicts vary greatly. Some cases are resolved through judicial decisions and new environmental impact studies, while others are characterized by the repression, criminalization or even killing of activists.

15 See the chapter on agriculture.

Figure III.4
Latin America and the Caribbean: estimated consumptive water use as a share of total extraction, 2022
(Percentages)



Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), AQUASTAT [online database] https://www.fao.org/aquastat/en/databases/.

Note: The figures for Central America do not include Mexico. The data for each subregion and global data were calculated by adding the annual extraction data in cubic metres for all the constituent countries.

5. Quality and pollution of bodies of water

Surface water courses, groundwater, coastlines and oceans have all been progressively polluted by economic and urban activities, which has been compounded by lax and inadequate regulatory frameworks and low enforcement capacity. In many cases, the regulations have remained in force for lengthy periods and were established when the absorption, dilution and resilience capacity of aquatic ecosystems was sufficient to process anthropogenic pollutant loads that were lower at the time. In general, both water quality regulations and compliance have advanced at a rate that has not kept pace with the rising amounts of waste discharged into watercourses and water bodies.

The improvements needed in drinking water and sanitation services would contribute to reducing pollution, since the main source of pollution in the region's urban areas is the failure to treat domestic wastewater (Sancho, Ribera and Arce, 2018). In addition, the volume of wastewater has increased on account of growing urbanization and the expansion of basic services that are not managed safely (UN-Water, 2019).[16]

On average, barely 40% of wastewater is safely treated in Latin America and the Caribbean, and the proportion varies widely from one country to the next.[17] Wastewater treatment can bring a variety of benefits to the region, especially if circular systems are established at treatment plants (Saravia Matus and others, 2022b). It is estimated that almost a quarter of the total length of Latin America's rivers is affected by severe pathogenic contamination —concentrations of faecal coliform bacteria of more than 1,000 units per 100 ml— a figure that rose by almost two thirds between 1990 and 2010. Most of this water pollution originates from domestic wastewater and sewage (UNEP, 2016c). In 2019 alone, it was estimated that the region had lost as many as 2 million disability-adjusted life years (DALYs) from diseases related to lack of access to safe water and sanitation (WHO, 2023).

Another challenge in the provision of these services is protecting the water sources that humans use. The water cycle must be safeguarded to protect the availability, catchment and quality of water in the future and to increase climate change resilience, by conserving or restoring aquatic ecosystems and their environmental services and implementing mechanisms for adapting supply systems and others, mainly in the basins that supply the region's large cities. Strategies must also be implemented to effectively deal with potential disasters and extreme events, including pollution and sedimentation caused by large variations in rainfall, storms, and landslides. Preparations must be made for sudden water supply cuts and prolonged droughts caused by the hydro-climatic changes described above, since in most of the region's urban centres, such provisions remain nascent at best (Saravia Matus and others, 2023). In fact, over the long term, many of the region's cities will face situations of extreme scarcity due to population growth and the decline in water catchment sources and the volumes available from them. Lima, for example, is supplied by the watersheds of the Rímac, Chillón and Lurín rivers, whose source is in the Andes, in snow-capped mountains and glaciers that have shrunk by 43% over the past 40 years as a result of ice melt linked to rising temperatures. The city therefore has potential water availability of 125 m^3 per inhabitant per year, one of the lowest figures in the region, along with Rio de Janeiro and Mexico City (González and Vacher, 2014). Another significant case is that of Santiago, where the water supply depends on meltwater and where, in the context of the megadrought, there is a precipitation deficit of between 20% and 40%, resulting in a decrease in snowpack, reservoir volumes and groundwater levels (Garreaud and others, 2019).[18] To date, the megadrought in central Chile has lasted for 13 years and is the longest in 1,000 years, making Chile the leading country in the region's water crisis (WMO, 2022). Climate change and the increase in the melt level have made the situation even more critical in Santiago, and water cuts are foreseeable due to the increase in turbidity caused by excess sediment (Donoso and others, 2018).

16 Latin America and the Caribbean have experienced a rapid process of urbanization, as a result of which more than 80% of the population now live in cities.

17 In 2020, the proportion of safely treated wastewater in the region's countries was as follows: 13% in El Salvador, 21% in Colombia, 23% in Costa Rica, 24% in Cuba, 24% in Suriname, 31% in Ecuador, 33% in Brazil, 36% in Argentina, 58% in the Plurinational State of Bolivia, 60% in Mexico and 91% in Chile (United Nations, 2022).

18 This drought has been so extensive in terms of duration and geographical area that it has been called a megadrought.

6. Water use in economic activities

It has been estimated that because of population growth, socioeconomic development and changing consumption patterns, water withdrawals have been growing at an annual worldwide rate of 1% since 1980.[19] This trend is expected to increase by at least 20% or 30% by 2050, without considering possible increases in consumption owing to unexpected events, as was the case with the pandemic (Serebrisky and others, 2020). Together with the fact that water availability will be more variable because of land-use change, pollution, overexploitation and climate change, new policies will need to be adopted to deal with droughts, floods, emergencies and other extreme phenomena. Stricter and more effective measures are therefore needed to promote rational water use, along with investments in infrastructure, technology and nature-based solutions to ensure better access and boost efficiency.[20]

(a) Agriculture

Agriculture is the main user of extracted water in the region, accounting for 76% of the water withdrawn for consumptive uses. To meet the demand for food, forage and biofuel in 2050, it is estimated that agricultural production will need to grow by nearly 50% compared with 2012 (FAO, 2017). As regards water resources, new irrigation practices that enable lower total extraction and sustainable intensification of water use will have to be adopted (UN-Water, 2019; UNESCO, 2015). Similarly, efforts must be made to promote the cultivation of native species or of species adapted to climatic conditions and whose water requirements are more easily adapted to the natural availability of water.

Another important challenge lies in the fact that 87% of the region's agricultural area is rain-fed (Mekonnen and Hoekstra, 2011). If rainfall patterns change significantly, production may become nonviable, especially for farmers who fail to invest in irrigation infrastructure and technology adapted to climate change, or in growing less water-intensive crops.

Current agricultural practices contribute to the overexploitation and pollution of the region's water resources, through the scope of water use, agrochemical pollutants and the sediments deposited in surface and groundwaters. Net soil loss from unwise agricultural practices and the salinization and waterlogging of irrigated land also contributes to this situation.

In Latin America and the Caribbean, fertilizer use more than doubled over the past 20 years (from 17 kg/ha to 39 kg/ha between 1999 and 2019) (ECLAC, 2022), while pesticide use rose from 388,000 tons to 870,000 tons over the same period (FAO, 2022). It is estimated that in 2010, about 10% of Latin America's total river length was affected by severe or moderate salt contamination. In addition, waste generated by livestock farming and waste from inorganic agricultural fertilizers (anthropogenic phosphorus, nitrogen and potassium) pollute the region's most important lakes (UNEP, 2016c). Similarly, excess nutrients reaching the sea produce algal blooms that consume oxygen and lead to the eutrophication of coastal areas: eutrophication is present in 31 areas in the region and a further 19 report hypoxia, and those areas are more concentrated on the Atlantic coast than on the Pacific.

19 *United Nations World Water Development Report* (UN-Water, 2019).
20 See the chapter on biodiversity.

Contaminated surface and groundwater and the use of wastewater also affect crops and livestock. In 2014, it was estimated that nearly half of the grain and livestock losses recorded in developing regions (worth US$ 13 billion) occurred in Latin America and the Caribbean as a result of hydro-meteorological events associated with climate change (FAO, 2021). In subregional terms, the hardest-hit territories are the Central American dry corridor, the central Andes, South America's Atlantic coast and the Caribbean islands (IPCC, 2021; Saravia Matus and Aguirre, 2019).

(b) Hydroelectric power

Hydroelectric power accounted for 43% of total electricity generation in Latin America and the Caribbean in 2021 and is an important element in the region's energy transition. However, hydroelectric production is threatened by the variability of hydro-meteorological dynamics, and it is also increasingly characterized by conflicts among users of the basins where it is pursued. Hydropower production and stability depends on the frequency and intensity of droughts, since they directly reduce water flows. At the same time, hydroelectric generation is often out of sync with the seasonal needs of other uses, especially agriculture. In the context of climate and water change, conflicts arise over the construction and operation of dams and canals for hydroelectric plants. Floods may also force reductions in reservoir water volume as a preventive measure to avoid overflows.

Several studies indicate that the negative impact of reservoirs on biodiversity has been underestimated. Dam construction poses considerable risks, such as the fragmentation of ecosystems, the alteration of rivers' hydrological regimes, modifications to how sediment is transported, effects on downstream water and food security, the relocation of human populations and greenhouse gases released by decaying vegetation (Gross, 2016; Hennig and Magee, 2017; Veldkamp and others, 2017; Räsänen and others, 2018; Best, 2019).

(c) Mining

In the region's mining countries, water used by that sector accounts for between 2% and 8% of total withdrawals (Lewinsohn and Salgado, 2017). Despite the relatively low withdrawal volumes, water use in mining often entails high potential for conflict with the local population because mining can contaminate water sources, such as springs or headwater basins, and because it is generally concentrated in high-altitude areas where water is scarce, or in arid or semi-arid areas where deposits are located. These conditions make mining a dominant local user in such territories, accounting for as much as 40% or more of withdrawals (Dourojeanni, 2019; Altomonte and Sánchez, 2016). In fact, the main water conflicts in Andean countries occur in the upper reaches of watersheds. In addition to extracting water, mining has the potential to alter watersheds, both on the surface (removal of soil cover or vegetation, alteration or damming of rivers, elimination of glaciers, modification of topography and so on) and below, and this harms downstream water availability. This is compounded by the risks caused by the accumulation of mine tailings and liquid industrial waste, which can overflow during extreme events or filter into groundwater. In fact, the accidental or deliberate release of mining waste and the transport of toxic waste from mining sites are the most frequent and most impactful causes of pollution (Dourojeanni, 2019; Altomonte and Sánchez, 2016).

7. Water and ecosystem services

Ecosystem services are vital for advancing sustainable development, since they reconcile economic production with the safeguarding of ecosystems through new models for development, production and consumption. The current and future satisfaction of human needs depends on countries' natural heritage and on innovation and value chains, in a way that inseparably links them with natural resources and environmental services.

The sustainability of the benefits of water ecosystem services is threatened by deforestation, climate change, rising temperatures, desertification, the expansion of the agricultural frontier, mineral extraction and pollution. There is therefore an urgent need to step up activities targeting appropriate watershed and freshwater ecosystem management, especially investment in projects for the conservation of the natural habitats that are essential to water cycles and the natural retention (or harvesting) of water. There are many projects involving such activities, but they are insufficient.[21] Despite the efforts made, significant losses have been experienced in some of the region's strategic water reserves —particularly, as described above, in retreating and disappearing glaciers— and this affects the ability to supply water and ecosystem services.

In addition, 346 of the region's wetlands have been recognized as Ramsar sites and are included on the List of Wetlands of International Importance (Valencia, Herrera and Tiribocchi, 2019). Among them is the world's largest wetland, the Pantanal, which covers an area of 200,000 km^2 and regulates the hydrology of vast swathes of South America (UNEP/WCMC, 2016). However, strategies and policies must be strengthened to underscore the importance of these sites, as well as to increase their protection through legislative and executive measures in order to ensure their conservation and financing (Valencia, Herrera and Tiribocchi, 2019).[22]

Since the late 1990s, several Latin American countries —such as Brazil, Costa Rica, El Salvador, Ecuador, Guatemala, Honduras, Mexico and Nicaragua— have implemented payment mechanisms for water ecosystem services with the aim of conserving and restoring those services. The mechanisms focus on protecting water supply by conserving forests, and in some cases by introducing changes in agricultural practices (Martin-Ortega, Ojea and Roux, 2013), and they are closely related to nature-based solutions, meaning green rather than grey infrastructure.[23] These programmes often benefit rural communities, Indigenous Peoples and forest-dwelling collectives, albeit with limitations.

8. Water-use efficiency and decoupling

Unfortunately, water-use efficiency is below the global average in almost all the region's countries. Efficiency —measured as the ratio between the value added of the entire economy and national water withdrawals (SDG indicator 6.4.1)— averages US$ 19 per m^3 in the world and US$ 12 per m^3 in the region, although individual countries' figures vary widely (see figure III.5).[24]

Decoupling is a fundamental principle for furthering the more sustainable management of natural resources, including water. Given that the region's development is heavily dependent on its natural heritage, boosting sustainability requires economic growth to be decoupled from the growing pressure on resources by creating greater value added, generating less waste and emissions and reducing their environmental impact to ensure the provision of environmental services to the economies of today and tomorrow. Decoupling allows more food, hydropower, minerals and other goods to be

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21 Examples of such projects include the Special Programme for the Restoration of Micro-watersheds in Priority Zones of the Cutzamala and La Marquesa System in Mexico, the watershed conservation programme for the city of Cuenca and the areas around Quito in Ecuador, the recovery programme using *amunas* in the upper reaches of the Rímac in Peru (*amunas* are techniques to recharge aquifers based on shared tasks of planting, cultivation and water harvesting) and the programmes underway in Brazil (CONAFOR, 2010; Itaipú Binacional, 2009).

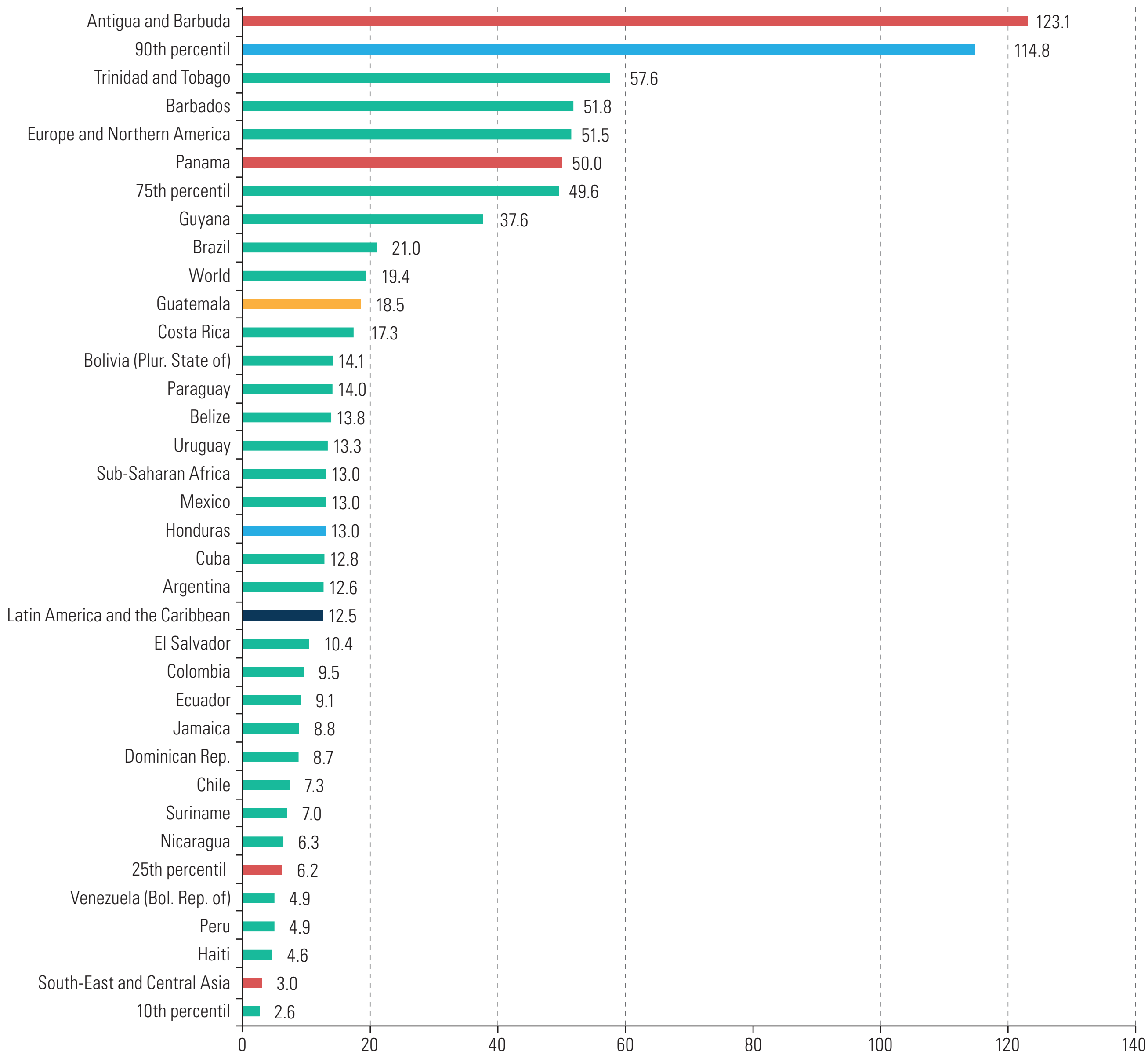
22 See the chapter on biodiversity.

23 Green infrastructure entails using vegetation (including forests), soils and natural processes to manage and regulate water, to maintain ecosystem services and to perform other functions. Grey infrastructure refers to urbanization and engineering works.

24 The economy is considered to be more efficient or to produce more economic value per m^3 of extracted water at higher values of SDG indicator 6.4.1, which in turn shows the water intensity of the economic value produced. Although the optimal approach would be to evaluate this indicator in each individual basin rather than for entire countries, the national scale serves as a starting point for analysis as it reflects the weight of water according to each economy's productive specializations.

produced while guaranteeing the human right to water and sanitation and minimizing or reversing negative externalities (such as overexploitation and pollution of water bodies) and contributing to the integrity of ecosystems and their proper functioning.

Figure III.5
Latin America and the Caribbean (27 countries): water-use efficiency (SDG indicator 6.4.1) compared to global and other regional averages, latest available year
(Dollars per m³)

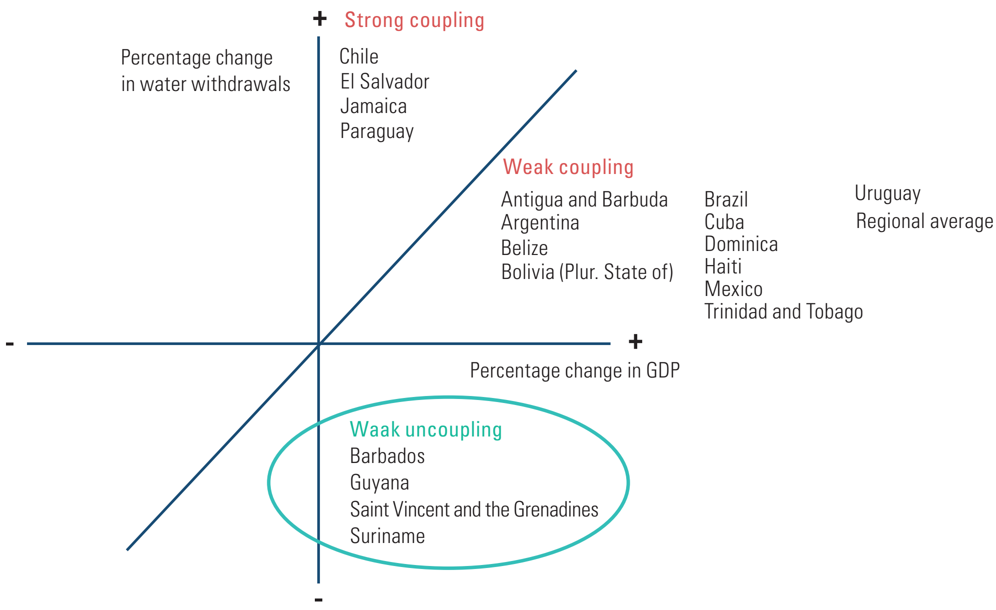


Source: Prepared by the authors, on the basis of United Nations, SDG Indicators Database [online] https://unstats.un.org/sdgs/dataportal/database.
Note: Water-use efficiency is calculated as the value added in dollars per cubic metre of water withdrawn.

In the 36 OECD countries, on average, water withdrawals have been decoupled from economic and population growth since 2000 (OECD, 2011). In contrast, the data available for Latin America and the Caribbean indicate an undesirable trend in which water withdrawals and GDP remain coupled (see figure III.6).[25]

25 Withdrawal figures do not include water that is returned to the water system after use (non-consumptive use).

Figure III.6
Latin America and the Caribbean (19 countries): water use coupling or decoupling by elasticity between annual GDP and water withdrawals, 1997–2018



Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en; Food and Agriculture Organization of the United Nations (FAO), AQUASTAT [online database] https://www.fao.org/aquastat/en/databases/.

Note: GDP is measured in constant 2010 dollars; water withdrawals are measured in m^3/year. Changes that occurred over a period of at least 20 years were included.

Ideally, countries would boost efficiency and sustainability and water use would be decoupled from economic growth. ECLAC studies show that decoupling in Barbados, Guyana, Saint Vincent and the Grenadines and Suriname is weak, as seen in the lower right quadrant of figure III.6. The upper right quadrant contains countries where coupling is present because both their GDP growth rates and water withdrawals have risen. In most of the 19 countries studied and the corresponding regional average, coupling was weak and GDP has risen more than water extraction. In other countries —namely Chile, El Salvador, Jamaica and Paraguay—coupling is strong and water withdrawals have grown faster than GDP. The regional average, calculated on the basis of the available estimates, also indicates weak coupling, in contrast to the decoupling seen in OECD countries. This can be partially explained by the fact that the more developed countries generally protect their own natural resources and import the products that require more water and have a greater impact on biodiversity (Lenzen and others, 2012 and 2013).

The trends of coupling and low efficiency described above indicate that high levels of pressure on water resources remain prevalent in the region. As a result, Latin American and Caribbean countries are already setting goals to improve sustainability in the many ways in which water is used. Those targets are part of countries' nationally determined contributions under the 2015 Paris Agreement, up to 66% of which contain actions related to water resources (Global Water Partnership, 2019). Those actions are primarily aimed at ensuring access to water, increasing water conservation, improving infrastructure (including natural storage), reducing the risk and impact of disasters and promoting efficient irrigation.

Water extraction fees, charges and tariffs are aimed at reducing negative externalities (such as overexploitation and pollution), recovering administrative costs (mainly those related to monitoring and oversight) and alerting users to the relative scarcity of water. If water extraction fees are relatively high, users will tend to use the amounts necessary and avoid excessive withdrawals, incentivizing the use of more efficient technologies and water conservation. Hence, water fees are important instruments in promoting decoupling and water efficiency. To send the correct signal, the extraction fee should cover not only the cost of the infrastructure and its operation, but also the condition of the ecosystem that is the source of the water and its capacity for renewal. Likewise, fees can send signals about the priorities assigned to different uses of extracted water (particularly during times of scarcity), favouring and ensuring human consumption first, followed by the requirements of critical ecosystems and the water cycle and quality, and lastly, productive uses. In most of the region's countries, fees or tariffs are set for water extraction or pollution in accordance with the established regulatory framework, or with political decisions related to water management. One of the main limitations of the concessions or allocations granted under this framework is fee assignment by volume or flow rate, since in practice the volume extracted is not verified and must instead be determined through assumptions.

B. Towards a sustainable and inclusive water transition in Latin America and the Caribbean: recommendations for governance and public policy guidelines

Latin America and the Caribbean face complex water use and water management challenges, which reflect the multiple and growing negative externalities that have arisen in recent decades and make it clear that the region is not on the right path to meet the targets of SDG 6 by 2030.[26] This unsustainable trend in water resource management must be reversed, especially in view of the increased variability of flows associated with climate change. To achieve this, the current systems for water resource and ecosystem governance must be transformed and strengthened to make them more cross-cutting and better integrated, and policies for investment and regulation must be adopted in order to simultaneously achieve the social, economic and environmental goals set out in SDG 6.

Promoting the strengthening and modernization of governance as a cross-cutting axis, ECLAC proposes the following four pillars for simultaneous action to drive a sustainable and inclusive water transition in the countries of Latin America and the Caribbean, in order to accelerate progress towards the targets of SDG 6 and address the challenges specific to each country:

(i) Guaranteeing the human right to safely managed water and sanitation, leaving no one behind, through a strong commitment to investing to improve and boost the efficiency of water resource management to close the existing coverage and quality gaps.

(ii) Promoting equitable and affordable access to water and sanitation services to eradicate water poverty, incorporating social fee schedules for the most vulnerable groups. Achieving this will require strengthening, coordinating and regulating the current delivery systems.

(iii) Reversing the negative externalities associated with the overexploitation of bodies of water and watercourses, the pollution of water bodies and the conflicts related to their use and ensuring the conservation and restoration of aquatic and related ecosystems and the flow of ecosystem services.

(iv) Providing incentives for the adoption of innovative practices and encouraging investments in technologies to increase productivity and resilience to climate change, thus making water management circular rather than linear.

[26] For a summary of regional and subregional progress towards the targets of SDG 6, see ECLAC (2023a).

The aquatic ecosystems from which water is extracted, its productive uses, and water supply and sanitation services are intrinsically linked to structural socioeconomic issues, forms of social organization, ecosystem and territorial dynamics, production and consumption models, and the governance and institutional architectures of the countries of Latin America and the Caribbean. A series of policy guidelines based on practical experiences is set out below. They are intended to serve both for improving governance and for designing initiatives, programmes and management instruments in pursuit of the goals set.

1. Recommendations on governance systems and regulatory frameworks for water and watersheds in Latin American and Caribbean countries

In addition to the necessary financial resources, the region's countries need to combine robust governance and effective national institutional frameworks to push harder for policies and plans to further their water transitions.

For governance to be effective and robust, water must be managed as an intrinsically cross-cutting element that brings together multiple actors with different roles: authorities, regulators, extractors, distributors, water managers or suppliers (community, municipal and private), supervisory bodies, and end users (domestic, industrial and agricultural). All these actors influence and participate in matters relating to water at different levels (local, municipal, provincial, regional and national) in territorial and national venues, where the highest rank reached by national water authorities is a vice-ministry or undersecretariat. At that level, the water authorities must lead all the agencies involved in water management, and they must interact with line ministries (agriculture, public works, energy and so on) as well as with directors and other authorities and managers.

In order to change the current inertia in water management, the main limitations of water governance systems must be addressed (Altomonte and Sánchez, 2016; Dourojeanni, 2019), including:

- Limitations in the regulatory and normative frameworks needed to guarantee the human right to water. Such frameworks should ensure quality access, encourage investment and contribute to conflict resolution by establishing clear priorities for use.
- Inadequate technical, organizational, and inter-agency coordination capacities among authorities, weak institutional and regulatory support, and limited budgets that do not allow for the effective implementation of oversight tasks or the adoption of behavioural modification tools that help contain and reduce negative externalities caused by overexploitation, pollution and water conflicts.
- Inadequate integrated water management support tools to enable intersectoral strategies to be designed. The implementation of such strategies requires solid information systems (including for monitoring and oversight), strengthened conflict resolution mechanisms and effective stakeholder participation, among others.

(a) Regulatory and normative framework

The first recommendation is for countries' legal frameworks to enshrine the human right to drinking water and sanitation at the highest level and for the sector's regulatory bodies to be strengthened.[27] In that legal context, conflict resolution

[27] In order to satisfy the human right to water by 2030 in terms of quantity, a minimum level of consumption must be guaranteed. There are varying estimates of what that consumption should be. UNICEF, for example, uses a figure of 20 litres per person per day, while WHO uses a lower amount of 7.5 litres per person per day to cover consumption and food preparation needs (Donoso, 2017). These figures amount to totals of 2,600 and 1,000 m^3, respectively, per inhabitant per year.

mechanisms can be established and strengthened when water scarcity arises, and clear priorities for use must be established. Those priorities must start with the universal human right to safe drinking water and sanitation, followed by subsistence activities, environmental requirements, and lastly, productive uses. All this must be done within a framework that does not encourage waste or overconsumption. The conflict resolution system must be mandatory, strike an appropriate balance and clearly demarcate the powers of the water authority, supplier and user organizations and the judiciary.

Second, the way in which water use concessions and rights are granted to individuals and corporations must be improved, so that they do not harm third parties, trigger negative externalities or exacerbate those that already exist. To ensure their proper functioning, water allocation or reallocation systems, as well as the rules for granting or revoking usage rights, must be at the highest level (ideally enshrined at the constitutional level), be uniform and mandatory, and ensure transparency, balance between supply and demand (including environmental requirements), high-quality and accessible information, and conflict prevention over the long term. Water laws should also stipulate that holders of concessions or rights must pay the fees corresponding to those titles, as well as fines if they cause environmental harm. As a general rule, pre-existing water-related rights and uses —traditional and Indigenous ones, for example— should be recognized, provided the use made of them is effective, beneficial, traditional and current, without prejudice to the establishment of standards for appropriate use. In addition to reviewing and updating water allocation methods, consistency between management powers and functions at the national, basin and user levels must be examined. These powers and functions must be clear and the operations at each level must be interconnected, as they define the balance between water supply and demand (Dourojeanni, 2019).

Because of fiscal constraints, it is advisable, if the legislation so allows, for at least the resources collected to go directly to the water authority, without first channelling them through general taxation, so that they are not diluted among other needs of the State. Even more important, however, is ensuring investment mechanisms for which funding is provided by the various sectors that are strategically dependent on water.

Third, there are not enough international transboundary water treaties in the region. While progress is being made in this area, it would be useful to create joint coordination, cooperation, development and conservation bodies, several of which are already operating (for example, the Amazon Cooperation Treaty Organization, the Trifinio Plan and others), as well as to publicize the principles of international law and common law that apply to watercourses and bodies of water in overlapping jurisdictions. In a context of increasing climate variability, there will be a growing need to bolster coordination and consensus among neighbouring countries, favouring damage prevention and equitable use based on the specific factors of each case.

Finally, with respect to the management and protection of glaciers, the lack or insufficiency of adequate conservation institutions and mechanisms leaves those ecosystems without appropriate protection. Mechanisms of that kind that are compatible with each country's legal system and promote the conservation and good governance of those natural resources will therefore have to be designed and adopted. Instruments and mechanisms for glacier conservation must take on board the complexity of the hydrological cycle. In the absence of special laws for glacier conservation, therefore, water legislation should incorporate the concept of glacier conservation, based on an ecosystem approach that duly takes into account watershed unity and integrity (IUCN, 2006).

(b) Water authorities in countries and territories

In view of the wide range of stakeholders involved in the management of the various territories and given that countries' water authorities are generally below the ministerial level, a national authority at the highest level in the government hierarchy (ministerial) should be strengthened or created to set water policies, with particular attention paid to its relations with the various sectors and users.

One notable example of the progress that the region's countries have made is the innovative approach to water governance adopted in the Dominican Republic. The Water Cabinet, created in 2020, meets weekly at the president's office, bringing together all the authorities and public agents involved in the planning and management of the country's water resources, including the Ministry of Economy, Planning and Development, the Ministry of Environment and Natural Resources, the National Water Resources Institute (INDRHI) and the National Institute for Drinking Water and Sewerage (INAPA). The Water Cabinet is a multi-institutional council that coordinates the State's water policy by assigning priorities to resolve the main challenges at the territorial level. Its work recognizes the triple dimension of water —a human right, an economic resource and a natural resource— which requires public investment in the sector amounting to more than US$ 8.5 billion (7% of GDP) to achieve the objectives of the Water Compact. That compact was submitted for public consultation and aims to preserve and promote water availability over the coming 20 years. These innovations are taking place in the country while the new national water authority is being discussed by the legislature.

At the national level, the main functions of the water authority are the following: allocation of water use at the territorial level, pollution control, resource evaluation and monitoring, registration of uses and users, water planning, evaluation and approval of works projects, technical determination of riverbank lines and protected areas, and administrative management of conflicts related to water use. It has therefore been recommended that the institutional design of the national water authority meet the following conditions (Jouravlev, Saravia Matus and Gil, 2021):

- The authority must be independent of sectoral uses (such as agriculture, energy, drinking water supply, infrastructure construction or business promotion) and must have sufficient decision-making power, operational capacity and financial, human and legal resources to discharge its responsibilities.
- The authority must have regular and independent funding and the autonomy to make decisions within legal frameworks, policies and plans. The terms of office of its authorities must also be stable so they are protected from political pressure, and it would be useful to establish clear responsibilities in the event that laws are broken.
- The authority must be at the same political level and administrative rank as the sectoral public entities with an interest in the resource; in practice, this means establishing it as a ministry or at the level immediately below.

The creation of watershed organizations is normally only justified in watersheds where the magnitude and nature of the problems and conflicts warrant higher levels of participation and coordination among the different stakeholders in seeking and implementing solutions. At the same time, one practical option is for the national water authority to decentralize its activities by watershed, as relevant.

Thus, river basin organizations are valid options for coordination and participation in water management decision-making processes. For them to function well, however, minimum conditions must be met, for example, sufficient funding and technical support.

A series of elements are needed so that those agencies can achieve effective and sustainable water management (Dourojeanni, 2019):

- National backing and support for the establishment and consolidation of watershed organizations made up of technical groups (agencies) and councils (bodies), as well as related specialized groups.
- Financial support for technical agencies, together with the granting of legal personhood and the establishment of permanent sources of financing, such as water use fees.
- Qualified personnel, from managerial to technical positions, for the technical agencies, whose positions are sufficiently stable and are unaffected by changes of government.
- A body or council (such as a board or committee) with the composition and representativeness required to facilitate the effective participation of public and private stakeholders and civil society.
- Significant rather than merely consultative roles for the councils, so that they can decide among the options presented to them by the technical teams.
- Establishment of watershed planning systems for water management, which are granted legal standing and equipped with approval protocols based on knowledge and participation.
- Provision of equipment to monitor watershed and design information and communication systems, for example by establishing watershed observatories.
- Oversight of compliance with laws and agreements.

Regardless of the foregoing and from a spatial perspective, watersheds and water regions are ideal territorial and ecosystem units for organizing water management, and they make it possible to determine how —and to what ends— interventions can target natural systems, including soil and water. One example of this is the new "Colombia, World Power of Life" National Development Plan for 2022–2026, in which water is the organizing principle for land use.

User organizations are also relevant stakeholders in water supply and management. In order for them to fulfil their mission, however, they need to be backed by public law, technical support and financing, given that water management requires compulsory participation, mandatory payments, and conflict adjudication and resolution mechanisms that are not necessarily consistent with private companies. Furthermore, user organizations cannot replace State functions, as they are inherently territorial, local and sectoral, and must therefore be subject to adequate oversight.

(c) Information and indicators for stronger water management

An accessible water information system must provide regularly updated metrics, reports and documents to measure and identify the various water management stages and processes and to support public sector transparency. This requires better, systematic monitoring of both the availability and use of surface and groundwater resources and of the state of the infrastructure that supports sustainable water use and less pollution.

To overcome the current inadequacy of systematic metrics, the opportunity offered by technology and innovation must be seized. Digitizing information enables the integration of social, economic and environmental data to provide a comprehensive overview of the territory, which facilitates a more sustainable water management model that takes account of the interdependencies between water uses. The establishment of an inter-institutional network comprising the agencies with water-related responsibilities is also highly advisable. All this will enable the establishment of water indicator systems that will progressively contribute to national statistics and provide information on water supply, withdrawal, use and quality. With robust quantitative information and integrated planning, a shared vision of the evolution and future of water resources and of the integrity of the affected watersheds and ecosystems can be created, which would strengthen land management. Those systems could also promote the establishment of monitoring and oversight mechanisms in the event that users create negative externalities. Similarly, the systems used to allocate water rights and uses must be monitored, since water extraction in the region is still often carried out without formal deeds and without oversight, especially in the case of groundwater. Statistical follow-up on the enforcement of water regulations and public policies is also required, and this is an area where a sociopolitical commitment to provide the necessary budget is vital to enable sustained supervision and monitoring over time and in all territories.

2. Managing water supply and demand in the face of climate change

The infrastructure for economic activities has developed based on a certain level of water availability over time and across territories. As of now, that availability is evidently lower, and since water quality has worsened because of pollution, new solutions must be deployed. They could include:

- Establishing priorities for universal access and water allocation, a matter of particular importance in arid or desert territories, during prolonged droughts and health crises and at times of catastrophe or disaster.
- Increasing the productivity and efficiency of multiple water uses in accordance with the specific features of territories and environments, which implies moving water-intensive crops to territories where conditions are optimal, improving soil water retention by incorporating organic matter, or adopting other measures.
- Increasing water availability or managing demand by incorporating circularity: for example, recycling or reuse, seawater desalination using renewable energy, reducing the associated pollution, and recharging aquifers.

These initiatives respond to persistent key challenges regarding the balance between water supply and demand. They also address the need to adapt management tools so that authorities can evaluate the options for addressing climatic and hydrological instability.

The circular economy concept entails reusing water over and over again, as in the natural water cycle. Two types of action can be taken to mitigate or resolve the effects of water scarcity in regions where there is a water deficit: improving management and obtaining new resources. The planned reuse of water is an obvious way to increase availability, since reclaimed water can replace the use of high-quality water (urban, recreational, industrial or agricultural), leaving those flows free for other more demanding purposes. This reuse reduces net water demand and pressure on natural systems, facilitates the recycling of nutrients for agricultural use, and reduces net discharges and ecosystem pollution. Reusing treated water is widespread in several developed countries, including Israel, which recycles about 75% of its wastewater, and Australia, where 82% is recycled (Cotec Foundation for Innovation, 2017). In pursuit of more circular management, wastewater must be treated to return it to its courses in a cleaner condition, a process that also recovers methane and material for fertilizers.

According to a study by Saravia Matus and others (2022b) that examined a sample of 75 wastewater treatment plants located in intermediate cities in five Latin American and Caribbean countries, the installation of methane recovery infrastructure requires an investment of US$ 251 million.[28] This would offer the potential to generate electricity equal to the amount consumed annually by 202,000 inhabitants. If the electricity produced were used for self-consumption, the wastewater treatment plants would obtain annual savings of up to US$ 46.6 million. Considering a time scale of 20 years and a discount rate of 12%, a net present income of US$ 342.2 million would be secured, resulting in a cost-benefit ratio of US $1.34.[29] In addition to reducing plant operating costs by approximately 40%, this would also result in an 86% drop in methane emissions. Moreover, it should be noted that the study does not assess the potential reduction in air pollution, which could improve the cost-benefit ratio. At the same time, greater energy efficiency in water and sanitation (which rely on energy from fossil fuels) would reduce operating costs and free up resources that could be used to renew or maintain infrastructure in need of essential upgrades.

Given that water resource management is facing increased uncertainty, proactive risk management assessments will be essential. For example, the design and operation criteria for work projects that have a useful life of several decades will have to be reviewed, to analyse their resilience to possible variations in climate conditions and extreme phenomena. In terms of hydropower, many reservoirs have been affected, which compromises their functioning during droughts or flooding. At the same time, the options for building new reservoirs are limited by sedimentation, less runoff and other environmental constraints. More ecosystem-friendly forms of storage must therefore be explored: for example, wetlands and natural moorlands, which help preserve moisture and recharge groundwater, or the incorporation of organic matter to improve water retention in the soil. This exploration must be carried out at the national, sectoral and watershed levels, to balance supply and demand. On a local scale, rainwater harvesting or capturing atmospheric water using solar compressors are nature-based solutions.

The size of irrigation zones must also be adjusted in keeping with current and future water availability by seeking consensus among users and communities (Peña, 2016). The best way to manage agricultural water demand is to increase water productivity; in other words, to achieve greater yields using the same amount of water. To achieve this, water must be better controlled, land must be better managed and farming practices must be improved (UNESCO, 2015). The principles of increased productivity, resilience and circularity must be followed in managing the water demand of each sector that uses it.

In watersheds experiencing prolonged drought or in very arid areas, water withdrawal restrictions will need to be much tighter to preserve equity of access and meet established priorities. The State, the private sector and communities must all invest in building watershed observatories that provide real-time data for implementing water-saving systems and processes, subsidize water-saving measures, promote circularity and reuse, restrict permits that are granted to expand the agricultural frontier and support for people affected by droughts.

This will require redesigning or adjusting current governance systems and management instruments. It is the responsibility of the political and judicial authorities to design the relevant incentives and controls so that industries can make business and investment decisions based on the public interest and environmental challenges. The current low (or zero) water allocation costs do not encourage productive sectors to invest in water efficiency (UNESCO, 2015).

28 Intermediate cities have between 300,000 and 2 million inhabitants. Some of those used for this particular study had as many as 2.3 million inhabitants and were located in Mexico, Costa Rica, Colombia, the Plurinational State of Bolivia and Peru.

29 If anaerobic technologies are used, the ratio increases to US$ 7.00.

In Latin America and the Caribbean, water funds are one of the nature-based solutions that can respond to the challenge of increased variability in hydro-meteorological flows. There are currently more than 20 in the region, notably those implemented by Quito, Rio de Janeiro and Santiago. These funds protect the availability of water by maintaining the watersheds that supply cities, which they do by restoring vegetation cover and through water management, environmental education, surveillance and monitoring of priority areas, and other similar activities. Mechanisms of this kind help modify the traditional paradigm so that people stop using rivers and start living with them, giving them space and building in harmony with nature. The region also offers other examples: the fact that local planning takes the conservation of the Jalca ecosystem into account in order to ensure the water supply in Peru, the restoration of an urban river in the Brazilian State of Pernambuco, and the sacred springs of the Amazon in Ecuador and Peru, which are intended to ensure water supplies for communities.[30]

There are other key elements that, in the context of climate change, can yield positive results in water availability and quality, and include green urban infrastructure —from regreening impermeable surfaces to green roofs— rainwater harvesting, water recycling for human and industrial consumption, irrigation for peri-urban agriculture, and the construction of green infrastructure to protect against extreme weather events. In this way, progress can be made from large infrastructure solutions towards technological solutions that are in tune with nature and implemented at the appropriate scale.

3. Investment drive to universalize drinking water and sanitation services

Quality drinking water and sanitation coverage can be universalized, with the resulting social and environmental benefits, if the much-needed investment to close the gaps (mainly in rural areas) is made, accompanied by subsidies for the most vulnerable sectors. Such an investment drive will reactivate the economy and employment and is also urgent to resolve the problems of public health and low standards of living caused by lack of access to drinking water and sanitation.

In distribution and collection infrastructure, it is estimated that the region's losses owing to inadequate maintenance and repair account for 60% of the total (CAF, 2018). Boosting investment is vitally important, given the decline in economic and social conditions in the region caused by cascading crises and the resulting fiscal constraints. Countries face the challenge of improving public policies to increase efficiency in how services are provided and how budgetary resources are used. In that context, the socioeconomic advantages of an investment drive in the drinking water and sanitation sector should be highlighted.

Globally, the benefits of universalizing access to safe water and sanitation exceed the associated costs at least three-fold (Hutton and Varughese, 2016). In Latin America and the Caribbean, the cost-benefit ratio is estimated at 2.4 for drinking water and 7.3 for sanitation (WHO, 2012). In the region's intermediate cities, implementing drinking water treatment systems with methane recovery facilities would reduce plant operating costs by approximately 40% and also offer a cost-benefit ratio of 1.34 per person (Saravia Matus and others, 2022b).

[30] Other examples of climate change adaptation include the following: the project for sustainable development, climate change adaptation and other conservation measures in the buffer zone of the Tamá National Park in Colombia, involving agroforestry activities, the conservation of managed areas and the creation of ecological corridors; and the functional watersheds to address climate change located in the Mexican State of Sinaloa, where integrated watershed management, ecosystem maintenance and recovery, stormwater management and ecosystem-based adaptation are being implemented.

The benefits of investments in closing the gaps in drinking water and sanitation coverage are numerous and would have significant economic, social and environmental impacts:

- It has been estimated that achieving universal access to safely managed drinking water and sanitation across the region would require about US$ 75 billion per year,[31] equivalent to 1.3% of the region's annual GDP over a period of 10 years. Such an investment could create 3.8 million new jobs over the decade.
- In the area of public health, closing the coverage gap is essential to promote hygiene, contain and reduce the spread of diseases and pandemics and improve the quality of life of communities. In addition, the availability of a continuous supply of quality drinking water reduces the incidence of other associated diseases that impose great socioeconomic burdens and weaken human capabilities.
- With respect to the social costs affecting the most vulnerable, paying for piped drinking water reduces the economic effort made by households that currently lack access and must resort to tanker trucks or other more expensive mechanisms, as a result of which they pay between 20 and 50 times more per cubic metre.
- In terms of environmental benefits, closing drinking water and sanitation coverage gaps contributes to the recovery of many water bodies that have been polluted by untreated wastewater, along with their related ecosystems.

This major investment drive to universalize coverage of safely managed water and sanitation is therefore a vital catalyst for the region's revival and development: it offers broad social and environmental returns and, at the same time, is crucial to guaranteeing the human right to safe drinking water and sanitation.

Long-term public financing must be mobilized in order to close infrastructure gaps, especially in rural areas and in many urban areas of lower-income countries, where the returns on these investments would generate social and environmental benefits. In the face of fiscal constraints, the involvement of the private sector is also important, even though it provides these services to less than 5% of the urban population in Latin America and the Caribbean and is highly concentrated in a few countries.[32] While some countries' laws prohibit private provision, others are working on regulations that would allow increased private sector involvement, as is the case with Brazil's Basic Sanitation Act of 2020 (Presidency of the Republic of Brazil, 2020). In any event, communities must be involved in the investments and their financing, and nature-based solutions must be identified and managed. Recently, public-private partnerships have been established, such as the 2022–2026 National Sanitation Plan in Peru, which provides for an investment of US$ 10.4 billion by 2026 to attain coverage targets.

In rural areas, where there are greater geographical and socioeconomic barriers to access, the State is indispensable, not only for the construction of grey or green infrastructure and the introduction of subsidies, but also for regulating the many informal providers that operate there. Encouragement must be given to formal provision through cooperatives or rural community entities that pursue not only economic gains but also social and environmental objectives. In addition, private investment could be incorporated over the long term, as the conditions described above are met.

As for the role of the private sector, conditions can be improved to favour investment, which may be preferable in cities with higher income levels and broad coverage, where basic infrastructure is generally available and consumer sentiment is positive.

31 In constant 2010 dollars.
32 Based on internal ECLAC estimates.

Those providers can more easily invest in water treatment and reuse with a more circular approach, which expands the opportunities for contributing to the sustainable water transition. All of the above requires a transparent and effective regulatory framework that avoids overcharging and transferring inefficiencies to users and also enhances opportunities for wastewater treatment and for capturing inputs for other productive processes.

In areas with lower population densities, infrastructure investments do not necessarily have to be grey, as there are more opportunities to adopt nature-based solutions, for both water conservation and wastewater treatment, together with communities.

There is a need for greater investment in the drinking water and sanitation sector by the public and private sectors and communities, and those investments must be accompanied by improved management capacities. That improvement requires establishing sustainable and solidarity-based tariff regulation, taking advantage of economies of scale where possible, promoting transparency, and reducing corrupt or unethical practices.

4. 2023 Regional Water Action Agenda

ECLAC has been working on the regional water agenda hand in hand with the countries of Latin America and the Caribbean and in partnership with agencies, programmes and institutions that are active in the region. There were more than 3,700 on-line and 200 in-person participants in the Regional Water Dialogues (ECLAC, 2023d) held in February 2023 at ECLAC headquarters in Chile, representing more than 30 of the region's countries. There were also 80 high-level panellists, including the Vice-President of El Salvador, ministers and vice-ministers from other Latin American and Caribbean countries, and renowned academics and activists. The objectives of the event were to communicate and consolidate the commitments made to accelerate the implementation of SDG 6 in Latin America and the Caribbean, to exchange experiences and lessons learned in relation to achieving the SDGs, and to formulate and approve a Regional Water Action Agenda with the voluntary commitment of the region's public and private sectors and civil society. The dialogues were structured around seven panels featuring representatives from non-governmental organizations, banks and the academic sector. A technical seminar day was also held under the auspices of the Kingdom of the Netherlands, which was opened by the country's ambassador. More than 20 community leaders attended, including Indigenous, Afrodescendent and rural representatives, and children and young people spoke.

The Regional Water Action Agenda for Latin America and the Caribbean was taken to the United Nations Water Conference in March 2023.[33] The Agenda is consistent with several previous treaties, agreements and strategies related to water management, and it calls for action to mobilize all available political, technical and financial resources in and for the region. The necessity and timeliness of including the voices of all stakeholders —especially those of rural communities, Afrodescendent territories and groups, Indigenous Peoples, women, children and young people— were taken into account in its preparation. The Agenda makes it clear that the region needs to take decisive action to advance towards the sustainable and inclusive water transition proposed by ECLAC. It establishes modern, democratic and participatory water governance in countries and territories as a cross-cutting principle and a key element for carrying out the actions indicated below and achieving the goals set. The Agenda's action lines are

33 See the Regional Water Action Agenda in ECLAC (2023e).

structured as follows: water and sustainable development; water and climate; water, financing and health; water and regional and territorial cooperation; water, energy, food and ecosystems; and brainstorming solutions.

The following are the areas of action and main commitments established by the Agenda: (i) bolster democratic water governance by strengthening regional, subregional, national and local institutions and technical decision-making capacities and progress resolutely towards the sustainable and inclusive water transition; (ii) adopt integrated water resources management practices to increase climate change resilience and mitigate the impact of disasters; (iii) develop new investment models and establish public-private partnerships with a range of actors from civil society and local communities to access funding and promote a new culture and appreciation of water; (iv) harmonize policy processes related to decision-making, monitoring and management of transboundary shared waters, recognizing community and Indigenous Peoples' management within a framework of dialogue and with a view to forging inclusive water management partnerships; and (v) support water training and technical assistance efforts at all levels and in all sectors.

C. Conclusions

The region's main water challenges are ensuring universal access to safe and equitably managed drinking water and sanitation and protecting water sources that are threatened by climate change, extreme events, overexploitation, anthropogenic pollution, and inefficient and inadequately coordinated water management. To address these challenges, a transition in the way people relate to water has been proposed. This transition requires modernizing and strengthening governance and is based on four pillars of action: (i) investment to guarantee the human right to drinking water and sanitation, (ii) affordable and equitable fee systems, (iii) reduction of negative externalities, and (iv) circular water management.

In 2023, the region is not on track to achieve the targets of SDG 6 by 2030 or has made only very slow progress. In order to make substantial progress with the pillars of the water transition in line with the targets of SDG 6, a series of recommendations is presented, which involve redesigning the region's water governance systems to strengthen water authorities and improve their budgets, regulatory frameworks and management tools.

Clear and inclusive multi-stakeholder governance is essential to mobilize the financial resources needed to close infrastructure gaps, adopt new circular and nature-based technologies, and improve the sustainability of water-related ecosystem services. In other words, greater efforts are needed to expedite investments and offer innovative contractual and institutional arrangements that enable the participation of the private sector, development banks, the public sector and communities. Both the governance and financing of water depend on coordinating actors both inside and outside the sector. In light of the above, the water transition must also go hand in hand with the energy transition, the agroecological transition and the mining transition, as well as with greater protection and integration of biodiversity to promote a substantial change in the development models of the Latin American and Caribbean region.

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CHAPTER

IV

Biodiversity as a basis for the transition towards sustainability and social, economic and environmental resilience

A. Diagnostic of biodiversity in Latin America and the Caribbean

B. Biodiversity governance

C. Conclusions and recommendations

Bibliography

A. Diagnostic of biodiversity in Latin America and the Caribbean

1. Biodiversity: a region privileged in biocultural heritage

Latin America and the Caribbean is a region privileged in terms of biodiversity, medicinal species and the genetic reservoir of wild relatives of cultivars. This diversity occurs at different levels: landscapes, ecosystems, species (many unique), genetic varieties and varieties of cultivars from processes of ancestral domestication (see box IV.1). All of these factors represent major contributions of nature to human well-being. Latin America and the Caribbean is considered by some to be the world region with the greatest biological wealth (UNDP, 2010; WCMC, 2016) (see figure IV.1) and this may be seen in the fact that is has the largest number of terrestrial and marine ecoregions, a proxy for different ecosystems and life forms (see maps IV.1 and IV.1). Latin America and the Caribbean is very heterogeneous and its biological richness is highly concentrated in some countries. For example, 6 of the 17 world's megadiverse countries are in this region, with approximately 70% of terrestrial biological diversity and high endemism in an area of less that makes up 12% of emergent land: Bolivarian Republic of Venezuela, Brazil, Colombia, Ecuador, Mexico and Peru (Biodiversity A-Z, 2020; Álvarez Malvido and others, 2021; CONABIO, 2020).

Box IV.1
What is biodiversity?

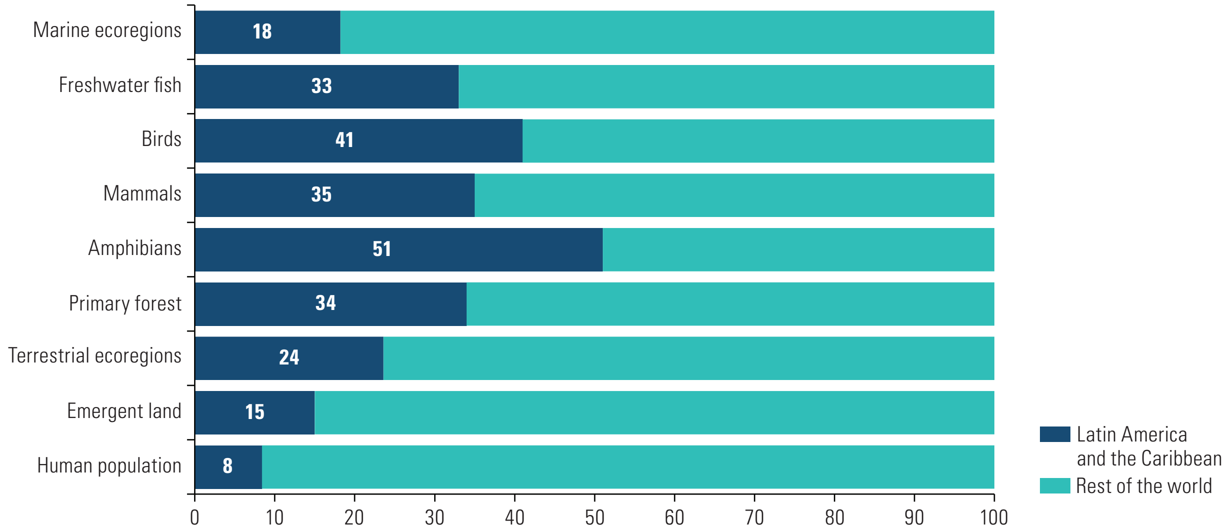
The concept of biodiversity or biological diversity refers to the enormous variety of life existing on Earth, resulting from billions of years of evolution and natural processes, which is increasingly being affected by the influence of human beings.[a] The concept encompasses all the levels at which this diversity occurs and is structured and coexists. It ranges from the variety and combinations of genes that exist in the same population and the interaction between the individuals in that population with their physical environment and with other species and communities that make up an ecosystem, to the spatiotemporal interrelationships between ecosystems through landscapes, migratory species and nutrient cycles, among other things.

Biodiversity recognizes no borders. Its components are interconnected (in interdependent processes) and it forms a transversal basis for cultural and socioeconomic development. It is also a heritage that enables other assets and, providing its functional processes remain in good condition, it is self-regenerating. In an analogy with the financial system, it reduces risk and uncertainty and supports the stability of the system on which all humanity depends (Dasgupta, 2021).

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of P. Dasgupta, *The Economics of Biodiversity: The Dasgupta Review. Abridged Version*, London, HM Treasury, 2021.

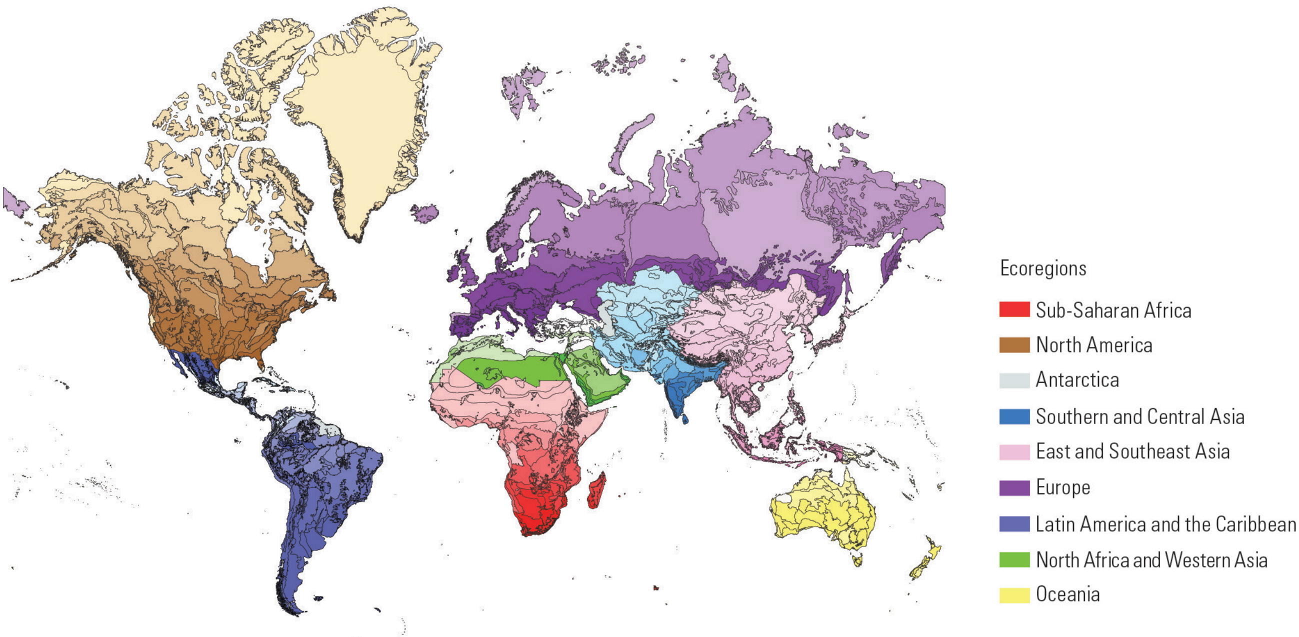
[a] See the definition given in the Convention on Biological Diversity [online] https://www.cbd.int/convention/articles/?a=cbd-02.

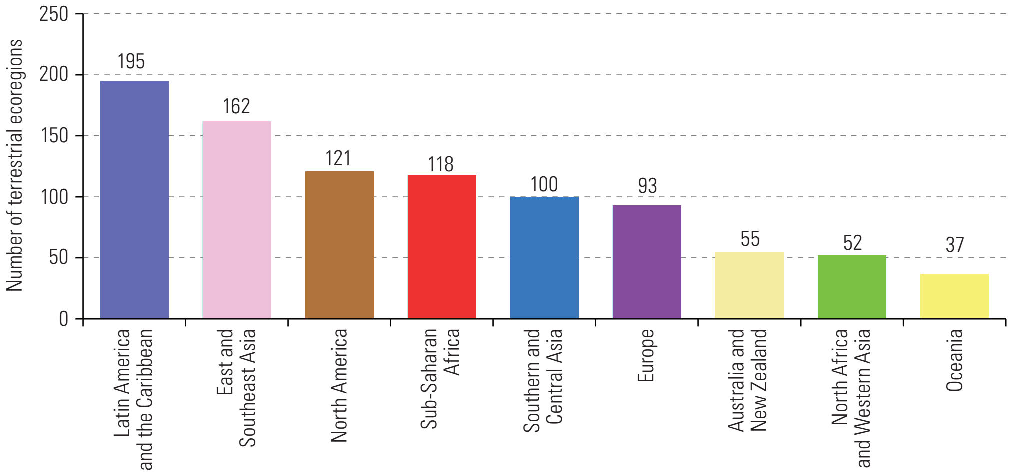
Figure IV.1
Latin America and the Caribbean and the rest of the world: proportion of biological attributes
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations Development Programme (UNDP), *Latin America and the Caribbean: A Biodiversity Super Power*, 2010 [online] https://www.undp.org/latin-america/publications/latin-america-and-caribbean-biodiversity-super-power; CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en; E. Dinerstein and others, "An ecoregion-based approach to protecting half the terrestrial real", *BioScience*, vol. 67, No. 6, June 2017; World Wide Fund for Nature International (WWF), "Ecoregions" [online] https://www.worldwildlife.org/biomes; M. D. Spalding and others, "Marine ecoregions of the world: a bioregionalization of coastal and shelf areas", *BioScience*, vol. 57, No. 7, July-August 2007, and United Nations, "Methodology", Statistics Division [online] https://unstats.un.org/unsd/methodology/m49/overview.

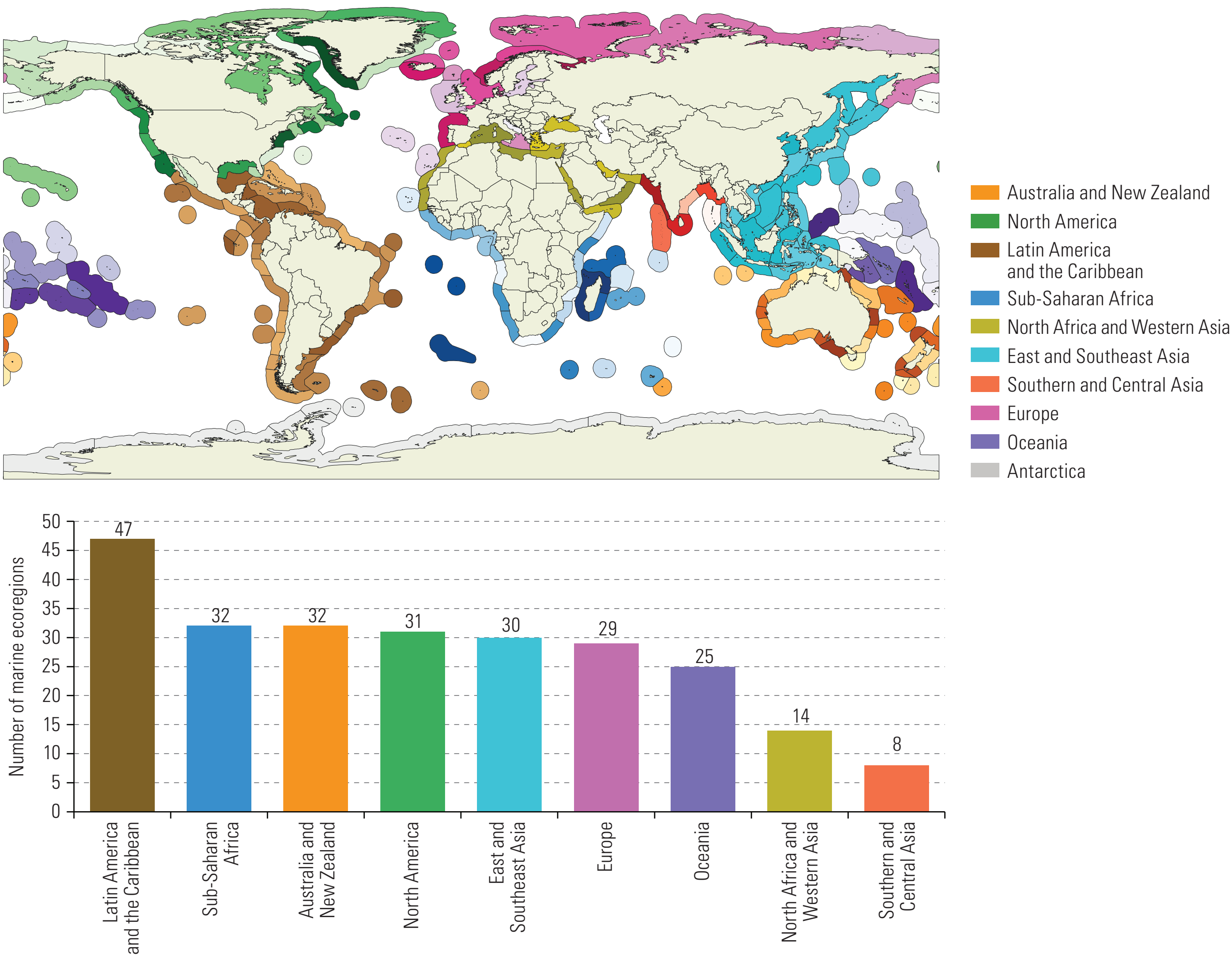
Map IV.1
Terrestrial ecoregions and frequency by world region
(Number of ecoregions)





Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of E. Dinerstein and others, "An ecoregion-based approach to protecting half the terrestrial real", *BioScience*, vol. 67, No. 6, June 2017, and World Wide Fund for Nature International (WWF), "Ecoregions" [online] https://www.worldwildlife.org/biomes.

Map IV.2
Marine ecoregions and frequency by world region
(Number of ecoregions)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of M. D. Spalding and others, "Marine ecoregions of the world: a bioregionalization of coastal and shelf areas", *BioScience*, vol. 57, No. 7, July-August 2007; World Wide Fund for Nature International (WWF), "Ecoregions" [online] https://www.worldwildlife.org/ biomes; and United Nations, "Methodology", Statistics Division [online] https://unstats.un.org/unsd/methodology/m49/overview.

The oceans and seas are very important to Latin America and the Caribbean. In 23 of the 33 countries that make up the region, the national territory has a larger marine than terrestrial surface area or an exclusive economic zone, and more than 27% of the population lives in coastal areas. The marine territory has an oceanic, island and coastal diversity about which much remains unknown. The Caribbean is particularly rich in marine species —12,000 recorded—, more than any other part of the region (Miloslavich and others, 2011) and the Caribbean coasts of Mexico, Belize, Guatemala and Honduras are home to the second largest coral reef system in the world.

Latin America and the Caribbean also has a rich cultural and ancestral diversity that has grown up within the framework of the region's biodiversity and has given the planet dozens of cultivated and domesticated species that are part of the world's basic diet, such as maize, tomatoes, potatoes, pumpkins, quinoa, cocoa, tobacco, agave, guava, prickly pears, annatto, vanilla, cotton, among many others (Sarukhán and others, 2017). Mesoamerica has over 200 documented domesticated and cultivated species and between 600 and 700 species, fruits or plants parts that are collected from the wild, but not cultivated. However, knowledge of their uses or benefits tends to be localized and these products are often disregarded or not encouraged, whereas in fact they could offer food sources or by-products with a strong commercial potential in different branches of the bioeconomy (Rodríguez and Meza, 2016). It is also strategic to maintain and protect areas where wild relatives of cultivars and the greatest possible number of their varieties are distributed, and adopt systems to record biodiversity and cultural richness to prevent knowledge from being lost. This would contribute to maintaining food security and improving adaptation to climate change.

The American continent is home to only 13% of the world's population, but it has 40% of the world ecosystem's capacity to produce nature-based materials and to assimilate byproducts from their consumption (process waste), so that nature provides three times more resources per capita in this region than are available to the average global citizen (IPBES, 2018).

2. Ecosystem services and nature-based solutions

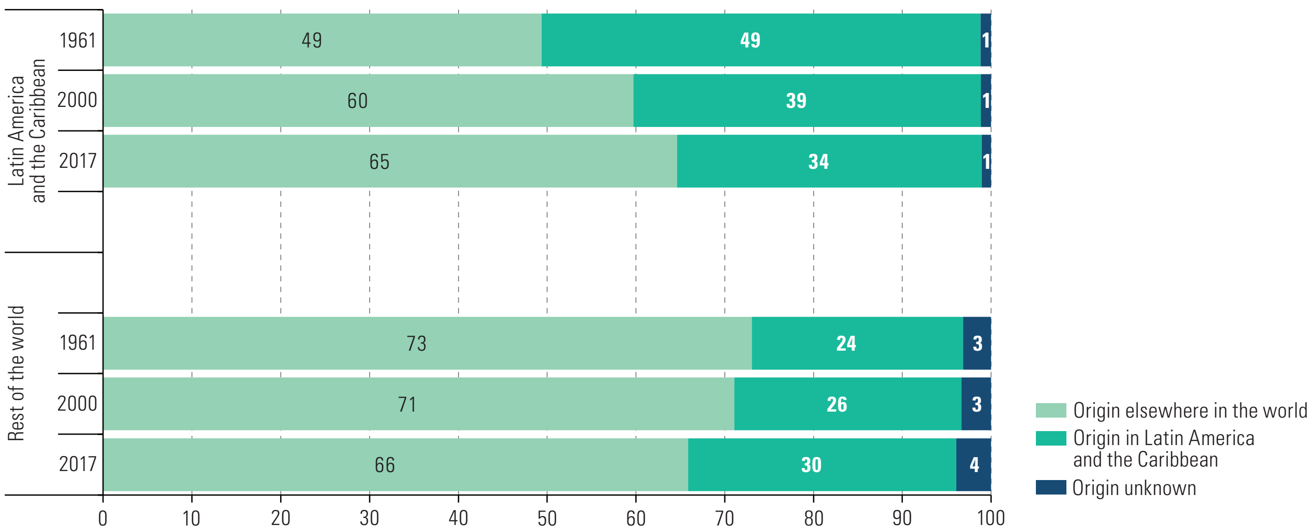
Natural ecosystems are the first source of filtration of human and natural waste, maintaining water and air quality and forming the main basis for food, energy, medicines, raw materials, jobs and production chains. Many industries depend on ecosystems, whether directly, as in the cases of tourism and fishing, both directly and indirectly, such as fashion and construction, or indirectly, as in banking and other services. The World Economic Forum (WEF, 2020a) estimates that about half of global GDP depends to a high or moderate degree on nature. In Latin America and the Caribbean, about a fifth of all jobs depend largely on biodiversity, especially in the following sectors: agriculture, forestry; fishing; food, beverages and tobacco; wood and paper; bioenergy; hydrology; textiles; chemicals, and tourism (ECLAC/ILO, 2018). The scale of the data gives an idea of how strongly social well-being is linked to biodiversity. Ecosystems perform a wide variety of processes from which people benefit directly or indirectly to meet basic and cultural needs. These processes have been termed "environmental goods and services", "ecosystem services" and, more recently, "nature's contributions to people", and have been classified into four broad groups: cultural services, provisioning services, regulating services and supporting services (MA, 2005; Iniesta-Arandia and others, 2014; IPBES, 2018).

(a) Provisioning services

When biodiversity is well conserved, it provides a safety net for billions of people around the world. An estimated 1.6 billion people depend on forests for jobs, livelihoods, food and fuel; one in eight people depends on fishing for their livelihood, and more than 4 billion depend on medicines from medicinal plants (UNDP, 2010). In Latin America and the Caribbean, more than 73 million people live in houses that use forest products as the main building material, accounting for 12% of the total number of households (Hickey and Wellenstein, 2020). In this region so rich in biocultural heritage, the rural population has the world's highest environmental income from forestry and non-forestry extraction —not necessarily monetary income— among the different types of income documented (for which they need healthy ecosystems), with 31% of total income. Latin America and the Caribbean is followed, in descending order, by Sub-Saharan Africa with 29%, East Asia and the Pacific with 24% and South Asia with 15% (Noack and others, 2015). This income also enables much of the population to stay above the global poverty line (Noack and others, 2015).

One of the most important provisioning services from biodiversity is its contribution to food security, through food production. Agricultural products are a major economic driver for Latin America and the Caribbean; however, exports do not fully reflect the potential of native biodiversity. Exports are concentrated in ever fewer species, which have practically doubled in land coverage. The paradox is the region's trend towards the production of non-native crops (especially soybeans, sugar and coffee), when it has made an extraordinary contribution to crops elsewhere in the world (for example, maize, beans, cotton and groundnuts): 30% (and rising) of the cultivated area in the rest of the world is under crops that are native to Latin America and the Caribbean (see figure IV.2).

Figure IV.2
Latin America and the Caribbean and the rest of the world: proportion of land cultivated with products native to the region, 1961, 2000 and 2017
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online] https://www.fao.org/faostat/en/#home and C. K. Khoury and others, "Origins of food crops connect countries worldwide", *Proceedings of the Royal Society B*, vol. 283, No. 1832, 2016.

Note: The products included as native to Latin America and the Caribbean in the work of Khoury and others (2016) are: avocados, beans, Brazil nuts, cashews, cassava, chilies and pimientos, cocoa beans, cottonseed oil, peanuts, lupins, maize, mangoes, mangosteens and guavas, yerba mate, palm oil, papayas, peppers, pineapples, potatoes, pumpkins and squash, quinoa, roots, others, strawberries, sweet potatoes, tea (commodity of the group), tomatoes, vanilla, yams and yautia.

(b) Regulating services

Since the coronavirus disease (COVID-19) pandemic, much attention has focused on zoonotic diseases and the future risk of other pandemics or diseases. Seventy per cent of emerging diseases and almost all known pandemics have occurred as a result of contact of domestic animals or humans with the wild. Land-use change has been the greatest single driver of new diseases reported since 1960 (over 30%) (IPBES, 2020). There is evidence that healthy ecosystems help to reduce the risk of future pandemics and protect human health, both directly and indirectly. Highly diverse and healthy ecosystems regulate the abundance of species that are primary reservoirs of viruses (as no species is strongly dominant over the others), which reduces the transmission of pathogens such as hantavirus, Puumala virus and the viruses that cause Lyme disease, West Nile fever and leishmaniasis. Greater diversity of species in well-conserved habitats has the effect of "diluting" possible sources of infection by bacteria and viruses (Suzán and others, 2009; Rubio, Ávila-Flores and G. Suzán, 2014; Mendoza and others, 2020).

(c) Supporting services

Ecosystem functioning is supported by processes such as soil formation, nutrient recycling and plant primary productivity, which are also beneficial to humanity. Two nutrients, nitrogen and phosphorus, help plants grow and are therefore crucial inputs in agricultural production. The use of fertilizers on an industrial scale exceeds 120 million tons per year (FAO, 2021a), but they are applied inefficiently, since less than a third of the nutrients are consumed as food and a large proportion end up polluting bodies of water and seas when they are carried by rivers (Marquet and others, 2018). Bacteria that facilitate nitrogen fixation and other beneficial microorganisms present in the soil offer opportunities for the development of biofertilizers —and other bioinputs— that could complement or partially replace the use of synthetic fertilizers. In addition to encouraging the use of bioinputs, agricultural production should pursue circular economy processes (for example, to recover phosphorus (P) that is lost or discarded from organic materials) to contribute to mitigating the impact of phosphorus depletion, a problem that warrants greater attention (Marquet and others, 2018).

(d) Cultural and recreational services

The aesthetic, spiritual, recreational and educational value of nature depends largely on the state of conservation of biodiversity, so there is no right or ethical way to put a price on it. Economics has used proxies to value the cultural and recreational services of ecosystems and create economic options for their preservation, for example, nature tourism and the direct and indirect income from. Tourism (including ecotourism) has grown substantially in the past 20 years. In 2019 it generated 10.4% of global GDP. It has also been behind the creation of one in five new jobs in the last five years (WTTC, 2019; Hickey and Wellenstein, 2020). In Latin America and the Caribbean, tourism's direct contribution to GDP grew by 7% in real terms between 2006 and 2019 and the sector employed about 6 million people directly and 15 million indirectly (WTTC, 2019; Hickey and Wellenstein, 2020). The region's countries are highly dependent on tourism, which accounts for 49% of total GDP in the Bahamas, 16% in Mexico and 10% in Argentina (see table IV.1). However, the sector saw a large drop in 2020 as a result of measures to control the spread of COVID-19. In 2020, international visitor arrivals fell by 61% in the Caribbean, the subregion most dependent on tourism, and by 72% in Central and South America. However, by December 2022 arrivals in the Caribbean and Central America were back up to almost 95% of their December 2019 value, while the recovery in South America has been slower, at 81% (UNWTO, 2023).

Table IV.1
Latin America and the Caribbean (30 countries): tourism and its direct contribution to GDP and national employment in 2019 and the role of nature in the main tourist attractions

Region	Country	Contribution of tourism to employment *(Thousands of jobs, 2019)*		Contribution of tourism to GDP *(Percentages, 2019)*		Contribution of nature and parks to the five main tourist activities
		Direct	Total	Direct	Total	*(Percentages)*
The Caribbean	Bahamas	56	119	19.5	48.8	100
	Saint Lucia	22	42	15.9	44.0	100
	Saint Vincent and the Grenadines	3	10	6.2	24.6	100
	Trinidad and Tobago	25	68	2.8	7.9	100
	Antigua and Barbuda	5	18	13.6	54.3	80
	Dominica	4	13	12.4	37.9	80
	Cuba	131	530	2.7	11.1	80
	Barbados	18	55	13.2	41.4	60
	Jamaica	118	382	10.7	34.4	60
	Saint Kitts and Nevis	2	7	6.7	27.2	60
	Dominican Republic	216	710	5.3	17.0	60
	Haiti	130	395	3.5	10.3	20
Central America	Costa Rica	112	272	5.2	13.2	100
	El Salvador	107	271	4.2	10.5	80
	Guatemala	181	503	3.0	8.2	40
	Mexico	4 149	9 025	7.2	16.2	20
	Honduras	200	553	5.6	15.1	20
	Panama	124	285	6.0	14.9	20
South America	Argentina	670	1 888	3.7	10.2	60
	Brazil	2 472	6 959	2.9	8.0	60
	Bolivia (Plurinational State of)	124	326	2.7	7.0	60
	Guyana	9	22	2.6	6.9	60
	Ecuador	165	385	2.3	5.6	60
	Chile	292	861	3.4	10.6	40
	Peru	429	1 381	3.9	9.9	40
	Suriname	3	6	1.3	3.0	40
	Venezuela (Bolivarian Republic of)	312	863	2.7	7.5	20
	Colombia	565	1 365	2.2	5.9	20
	Uruguay	60	171	3.7	10.7	0
	Paraguay	48	139	1.8	5.0	0

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en with data from World Travel & Tourism Council, World Bank and Tripadvisor [online] https://www.tripadvisor.com/ [accessed on 29 June 2020].
Note: The figures shown in the total columns refer to the sum of direct and indirect tourism.

(e) Nature-based solutions

Box IV.2
What are nature-based solutions?

Nature-based solutions may be described as interventions based on the management, reproduction or emulation of biological systems and processes that: (i) are inspired by and powered by nature; (ii) address societal challenges or resolve problems; (iii) provide multiple services or benefits, including biodiversity gain; and (iv) are of high effectiveness and economic efficiency (Sowińska-Świerkosz and García, 2022). They represent a broad scope approach, fostering innovative ways to manage the territory in a coherent and integrated manner, simultaneously addressing some of the following challenges established in the standard framework of the International Union for the Conservation of Nature (IUCN, 2020): climate change mitigation and adaptation, disaster risk reduction, economic and social development, human health, food security, water security, environmental degradation and biodiversity loss. Nature-based solutions offer benefits to a wide range of stakeholders, as well as society at large, generally at a much lower cost than non-natural alternatives, while maintaining opportunity costs as they alter natural ecosystems very little. There are other related concepts, such as green infrastructure, ecosystem-based adaptation and restoration.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of B. Sowińska-Świerkosz and J. García, "What are nature-based solutions (NBS)? Setting core ideas for concept clarification", *Nature-Based Solutions*, vol. 2, December 2022; International Union for Conservation of Nature and Natural Resources (IUCN), *Guidance for Using the IUCN Global Standard for Nature-based Solutions: A User-friendly Framework for the Verification, Design and Scaling up of Nature-based Solutions*, first edition, Gland, 2020.

A rapid diagnosis by ECLAC on nature-based solutions with a focus on the food-energy-water nexus in Latin America and the Caribbean, which included more than 110 experiences registered on online platforms, found that most of them are supported by governments and international organizations (top-down, 38%), followed by multi-stakeholder entities (30%), local organizations (bottom-up, 25%) and, in a much smaller proportion, private initiatives (6%) (González and Ortiz Monasterio, 2020). Of all these nature-based solutions, 75.5% address two to six different challenges simultaneously (for example, water security, food security, disaster reduction and biodiversity loss) and only 24.5% address a single problem. The priorities observed by subregion (in terms of the highest frequency of projects) are resolving ecosystem degradation and biodiversity loss, food security and climate change (in Mesoamerica); disaster risk reduction (in the Caribbean); and ecosystem degradation and biodiversity loss (in South America).

3. Pressure drivers that cause biodiversity loss and degradation

Human activities have transformed nature to such an extent, especially since the mid-20th century, that science considers humanity to be the main force of global transformation (Rockström and others, 2009). Over the past five decades, biodiversity loss and degradation has occurred at an unprecedented rate, owing to direct anthropogenic causes, such as overexploitation, and indirect causes, such as governance and economics (IPBES, 2019; Secretariat of the Convention on Biological Diversity, 2020) (see box IV.3). The major changes that affect the processes, cycles and functions of ecosystems are interconnected in a multivariate and non-linear manner, and they have a synergistic impact that makes them hard to understand and predict. These processes are referred to as global change and they include climate change, which is one pressure more in —but in turn amplifies— the sum of pressures that combine with each other (UC Global Change Center, n.d.).

Box IV.3
The role of the invisible in the relationship between biodiversity and the economy

The economy's relationship with biodiversity is complex. Biodiversity and its benefits have not been sufficiently valued from an economic perspective. According to the Dasgupta review (2021), certain properties of ecosystem processes and species as silent beings invisible to the human eye, together with their mobility, have prevented them from being correctly included in economic models. Most economic studies have treated nature as a "storehouse of resources waiting to be used" (McNeill, 2000) with no consideration of the limits that would have to be imposed on its use in order to ensure its regeneration and long-term preservation. The domain of the market economy lies in economic transactions between human individuals or groups and is based on rights of ownership over the goods being traded. Biodiversity and ecosystem services have elements that are goods of humanity overall and are not appropriable (public goods), thus their study lies in the field of public economics.

The prices of produced goods generally do not include actions of overexploitation, pollution or biodiversity degradation (since they are considered negative externalities) and they are not factored into markets, although the local consequences can severely affect health and social and environmental resilience. Furthermore, since those who benefit most from resource overexploitation are not usually the ones who suffer the related environmental impacts directly, they lack the internal incentives to contribute to sustainability. This has led to an increase in poverty and inequality among local —and not only local— populations where environmental damage, inequality and inefficiency accumulate. It is no coincidence that Latin America and the Caribbean, a major exporter of goods, but also an accumulator of negative externalities, is the region with the highest incidence of violent environmental conflicts (IPBES, 2019; Global Witness, 2022; Pedrero, 2023).

Economics presents limitations in placing a monetary value on global public goods and goods that cannot be valued monetarily (such as existence value or biocultural value). Conversely, returns on sustainable use are not only positive for the market economy, but are multidimensional because they contribute to social and environmental well-being and human rights, which are not priced in the market either. In that regard, the use of GDP as a metric for development has been part of the problem, since it fails to account for the depreciation of natural assets and represents incentives for the overuse of natural resources.

Given the intricate nature of ecosystem services, it is not easy to ascertain safe thresholds for the use of their components. The economics of natural resources should thus observe certain precautionary principles, intergenerational solidarity, environmental justice, common but differentiated responsibilities, progressivity and non-regression. Governance and political economy can change the rules of the unsustainable game in the economy-ecology relationship, in order to foster a progressive structural change towards sustainability.

An example in this connection is the work being done to articulate various models to offer alternatives to current economics (inertial baseline model) of the Legal Amazon in Brazil. By 2050, in the scenario of a new economy based on investments in conservation and expansion of natural resources, the bioeconomy, the adaptation of agriculture and the energy mix to a low-emissions one, around 312,000 jobs would be generated over the baseline model, employing 81% of all marginalized groups and replacing jobs in high-carbon chains, with output producing less than a fifth of the total emissions of the scenario baseline model and 81 million additional hectares of native vegetation.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of J. R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World*, New York, Norton, 2000; C. A. Nobre and others, *Nueva economía de la Amazonía brasileña*, São Paulo, WRI Brasil; P. Dasgupta, *The Economics of Biodiversity: The Dasgupta Review. Abridged Version*, London, HM Treasury, 2021; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), *The Global Assessment Report on Biodiversity and Ecosystem Services. Summary for policymakers*, S. Díaz and others (eds.), Bonn, 2019; Global Witness, *Decade of defiance: ten years of reporting land and environmental activism worldwide*, September 2022 [online] https://www.globalwitness.org/en/campaigns/environmental-activists/decade-defiance/; and M. Pedrero, "Hacia una recuperación económica transformadora de América Latina-Abya Yala: desafíos para garantizar los derechos colectivos de los pueblos indígenas", *Project Documents* (LC/TS.2023/35), Santiago, ECLAC, 2023.

As mentioned in chapter I, the unsustainability of nature-related production systems generates major conflicts and great uncertainty for many megaprojects. With about 8% of the global population and only 15% of the planet's continental land, the region has the highest number of killings of environmental and land defenders anywhere in the world, with 68%. Of the five countries with the most assassinations in the last decade (2012–2021), four are in Latin America and account for over half of the world's total killings (Global Witness, 2022). The situation is even more worrisome for Indigenous Peoples; despite representing 5% of the world's population, they are victim of 39% of attacks, while they are less protected by the State and saw an increase in impunity of illegal activities in their territories during the COVID-19 pandemic (Global Witness, 2022; ECLAC, 2020, Pedrero, 2023).

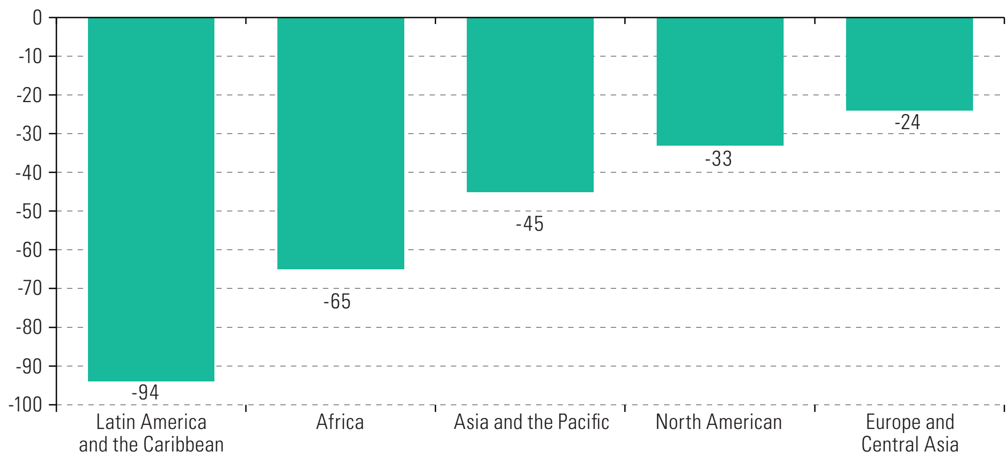
(a) Direct drivers

Latin America and the Caribbean has suffered biodiversity loss far in excess of the global average. The region has 10 of the 36 areas known as global biodiversity hotspots, which are areas of great concern for the planet owing to their threefold condition of great biodiversity, high endemism and loss of at least 70% of their original area (Conservation International, n.d.).

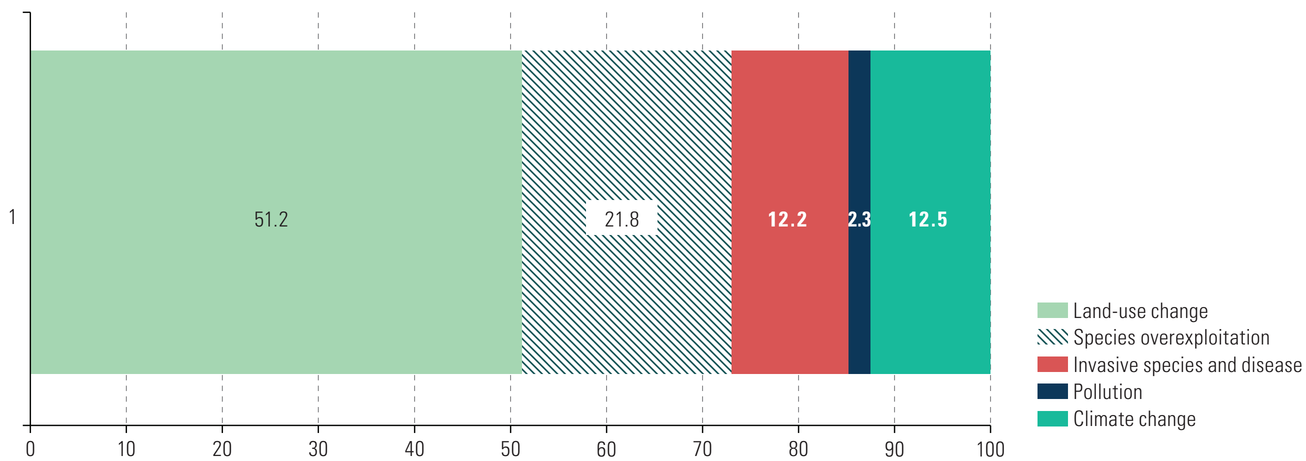
The Living Planet Index (WWF, 2020) shows the variation in the average abundance of populations of mammals, birds, fish, reptiles and amphibians from 1970 to 2016 in different world regions (Ritchie, Spooner and Roser, 2022). Latin America and the Caribbean has registered a dramatic 94% decline in the index, almost triple the proportion lost in North America. The main cause of the decline in biodiversity in the region is the loss and degradation of habitats, usually caused by changes in land use (for example, to convert forest or scrubland into agricultural land). The second cause is overexploitation (especially in capture fisheries). These causes are followed by climate change and pollution in similar orders of magnitude and, finally, the introduction of invasive alien species (see figure IV.3).

Figure IV.3
Latin America and the Caribbean: decrease in the abundance of vertebrate populations recorded by the Living Planet Index and the impact of the main threats to vertebrates, 1970–2016
(Percentages)

A. Living Planet Index, which tracks the abundance of vertebrate populations, by world region



B. Latin America and the Caribbean: main threats to populations of vertebrate species



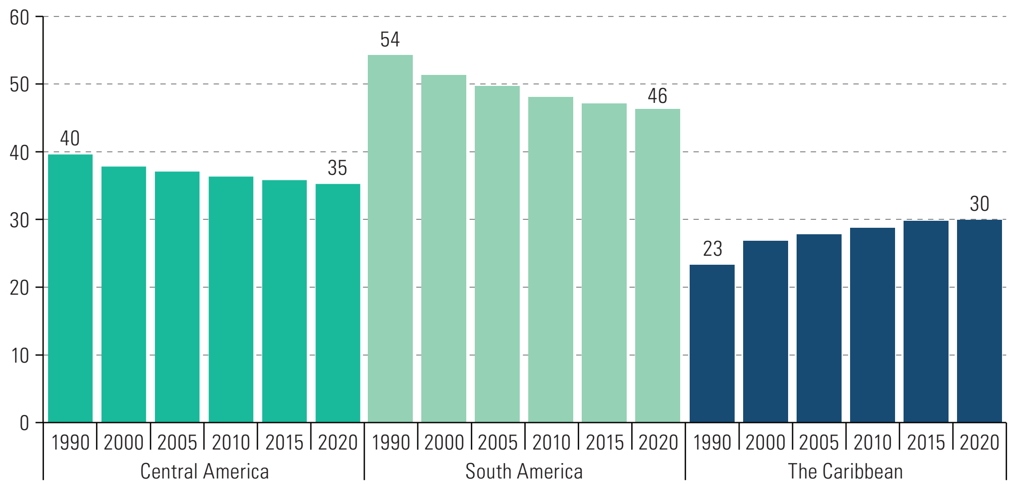
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Wide Fund for Nature International (WWF), *Living Planet Report 2020: Bending the curve of biodiversity loss*, R.E.A. Almond, M. Grooten and T. Petersen (eds.), Gland, 2020.

(i) Land- or sea-use change

At the global and regional levels, natural ecosystem decline and erosion caused by land-use change are the main cause of biodiversity loss, as species' natural habitats are eliminated or fragmented and some of their original conditions are degraded such that they can no longer support certain wildlife populations or ecosystem processes. The largest loss of forest area has occurred in the tropics, especially South America and Africa, although the rate of loss in these regions has decreased substantially in recent years of the analysis (FAO, 2020).

Between 2000 and 2020, Latin America and the Caribbean lost an area of natural forest larger than the Bolivarian Republic of Venezuela (95 million hectares) and was the region that contributed the most to native forest loss in the world. The loss in South America in particular is overwhelming: 89 million hectares of forest, at a rate of 4.5 million annually. Although the region's rate of forest loss is lower today than it was at the beginning of the century (see figure IV.4), notable major setbacks have occurred recently in several countries, including in Brazil and Colombia. Of the 20 countries that lost the most forest (excluding plantations) globally between 2000 and 2020, 8 are in Latin America and the Caribbean: Argentina, Bolivarian Republic of Venezuela, Brazil, Colombia, Mexico, Paraguay, Peru and Plurinational State of Bolivia. Conversely, six countries in the region gained forest during the period: Chile, Costa Rica, Cuba, Dominican Republic, Jamaica and Uruguay.

Figure IV.4
Subregions of Latin America and the Caribbean: proportion of total area covered by natural forest, 1990–2020
(Percentages)



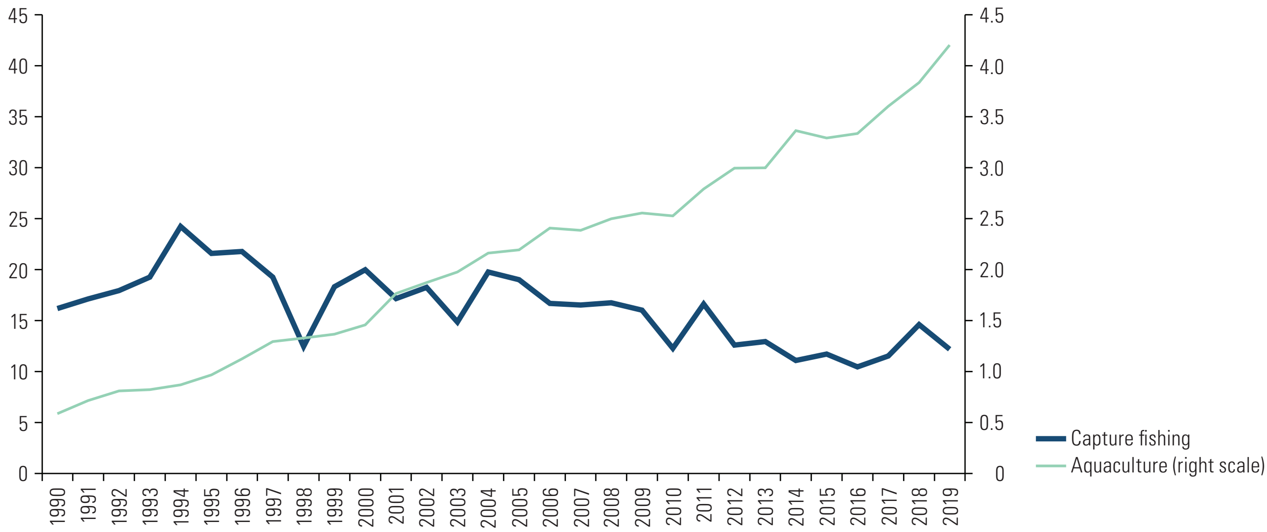
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and Agriculture Organization of the United Nations (FAO), FAOSTAT [online] https://www.fao.org/faostat/en/#home [accessed in April 2023].

At the twenty-sixth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, FAO reported that of global deforestation, calculated using satellite images between 2000 and 2018, 88.1% was due to the expansion of crop and livestock framing, a higher proportion than that based on the calculations from national reports, which placed the figure around 70% (FAO, 2021b). Other impacts of unsustainable agricultural systems on biodiversity are species overexploitation, overuse of pesticides and fertilizers, water pollution, soil erosion and contamination, and large areas of monocrops that oversimplify ecosystem relationships within landscapes and, in turn, erode the traditional diversified land use of ancestral cultures. Not only biodiversity, but also cultural richness is lost. Cultural homogenization is a driver of biological homogenization, producing a harmful feedback loop that further enhances biodiversity loss (Rozzi and others, 2018).

(ii) Overexploitation

Globally, it was estimated in 1974 that only 10% of marine fish populations were overexploited. In 2017 this proportion was 34.2% (United Nations, 2021), a pattern that is reproduced in the region. In Latin America and the Caribbean, capture fishing productivity decreased by 33.8% in the period 1999–2019 (taking an average of four years for the comparison intervals) (see figure IV.5). Overexploitation is causing an impact on marine resources that affects food security, economic activities and the ways of life of coastal communities. The fishing sector is an important provider of employment: in Central America, the Caribbean and South America this sector provides nearly 2.5 million jobs (Villanueva and Flores, 2016), which is another reason to progress towards sustainability, since its collapse would be catastrophic. Fisheries have been recipients of many opaque and sustainability-inconsistent incentives that have increased fishing capacity, manufacturing and illegal fishing; in turn, the use of fishing subsidies increases inequalities between fleets, communities —especially for artisanal fishing— and nations (Cisneros-Montemayor and Sumaila, 2019). On 17 June 2022, the World Trade Organization (WTO) reached a historic agreement (Agreement on Fisheries Subsidies) that prohibits subsidies for harmful fishing (from overexploited stocks, from unregulated areas of the high seas and illegal, unreported and unregulated fishing). Implementation of the Agreement will enable the parties to meet target 14.6 of the 2030 Agenda for Sustainable Development and is the first WTO agreement to focus on the environment (WTO, 2022). Conversely, aquaculture has increased more than fivefold in the last 25 years (see figure IV.5) and has great growth potential; this could reduce the pressure on some overexploited resources and could be sustainable if the necessary measures are taken to avoid eutrophication, the indiscriminate use of antibiotics or the escape of alien species, as the case may be.

Figure IV.5
Latin America and the Caribbean: capture fisheries production and aquaculture production, 1990–2019
(Millions of tons)

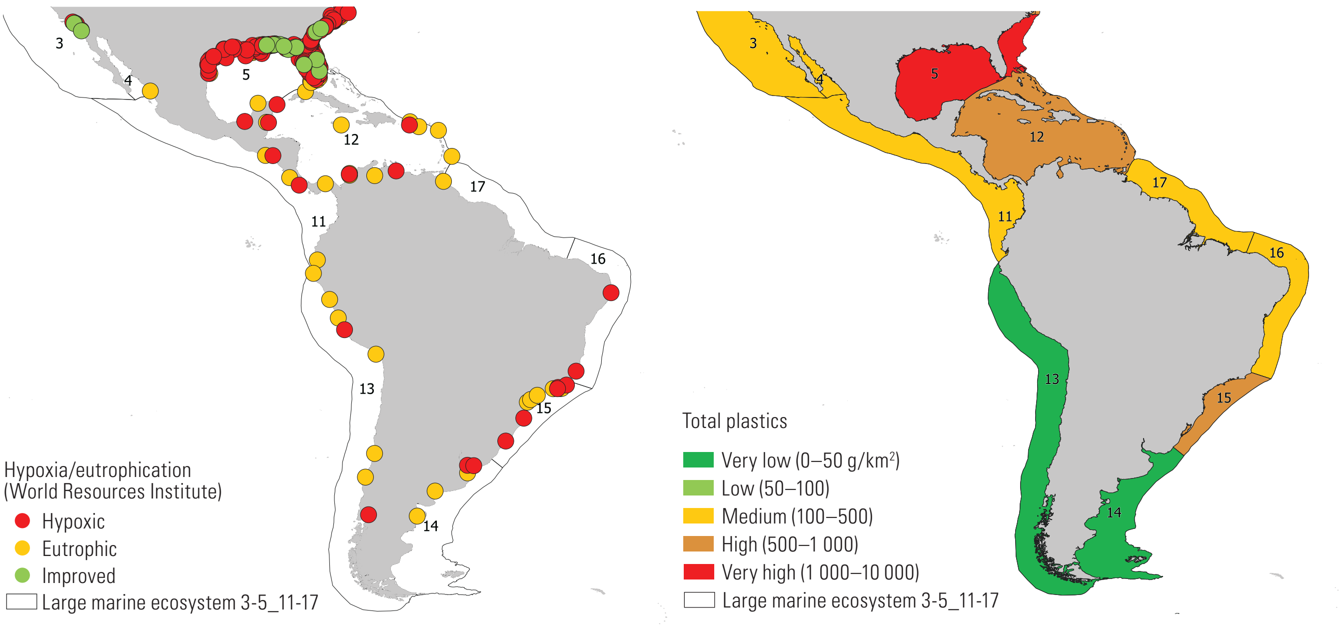


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/dashboard.html?lang=en&indicator_id=2019&area_id=726 [accessed in April 2022].

(iii) Pollution

Marine pollution should be a high priority for the region. Wastewater and nutrient runoff from inland cause coastal eutrophication (accumulation of organic waste that causes the proliferation of certain algae that consume oxygen), a phenomenon that can affect areas across thousands of square kilometres. In Latin America and the Caribbean there are 31 areas of eutrophication and 19 dead zones, which are areas with very low amounts of oxygen (hypoxic). There is also macro and microplastic pollution, in both cases due to discharges from inland sources (see map IV.3). Only the Humboldt Current in the South Pacific and the southernmost part of the Atlantic coast are below medium and high levels, while the Gulf of Mexico has very high levels of total plastic pollution (Tambutti and Gómez, 2020).

Map IV.3
Latin America and the Caribbean: marine pollution, areas of hypoxia and eutrophication, 2020, and plastics, 2016



Source: M. Tambutti and J. J. Gómez (eds.), "The outlook for oceans, seas and marine resources in Latin America and the Caribbean: conservation, sustainable development and climate change mitigation", *Project Documents* (LC/TS.2020/167), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2020.

Note: The numbers shown on the map refer to large marine ecosystem: 3 – California Current; 4 – Gulf of California; 5 – Gulf of Mexico; 11 – Pacific Central American Coastal shelf; 12 – Caribbean Sea; 13 – Humboldt Current; 14 – Plataforma de la Patagonia; 15 – Southern Brazilian shelf; 16 – Eastern Brazilian shelf; 17 – Northern Brazilian shelf.

(iv) Climate change

Although in 2019 Latin America and the Caribbean produced only 10% of global greenhouse gas emissions (Minx and others, 2021), it is very vulnerable to the consequences and, in turn, plays a fundamental role in worldwide absorption of carbon dioxide (CO_2). The region has 50% of the world's tropical forests, 25% of its mangroves, extensive areas of peatlands, seagrasses and other ecosystems that are highly effective as carbon sinks and thus contribute significantly to CO_2 absorption. However, the region's greenhouse gas emissions profile is very different from the world overall. Emissions from land-use change (mostly deforestation) represent 38% of the region's total emissions, compared to 11% for the world figure. Emissions from agriculture and forestry and other land uses represent 20% and 11% respectively (ECLAC, 2023).

Forest loss in the Amazon is of particular concern. These forests play a fundamental role in regulating climate and water worldwide, serving as major carbon sinks and generating "flying rivers," among other services. High rates of deforestation and the effects of climate change, which has increased water stress in the dry season, as well as fires and carbon emissions, have weakened this role to such an extent that recently the Eastern Amazon has no longer been functioning clearly as a carbon sink, but as a carbon source (Gatti and others, 2021). Meanwhile, increasing temperatures and ocean acidification are one of the main causes of coral bleaching in marine environments, although there are also other causes, such as pollution from excess nitrogen, low tides, disease and excess sunlight (WWF, 2019; IPBES, 2019; Lapointe and others, 2019). In Latin America and the Caribbean, 37% of the area of the Mesoamerican Reef System (the second largest coral reef in the world) has been eroded by acidification, and the Pacific Ocean area bordering Mexico and Central America has the lowest pH levels in the world, which is associated with coral bleaching. This poses a threat to several interconnected ecosystems and increases vulnerability to wave surges (WMO, 2021, Tambutti and Gómez, 2020).

(v) Introduction of invasive alien species

Invasive alien species are species of flora and fauna that become established in and colonize environments where they are not normally found. They are often introduced accidentally and have become one of the main threats to biodiversity worldwide as a result of the increase in global trade, transportation and tourism, with negative consequences for the productive sector (WWF, 2018). Invasive alien species often have some advantages over the native species, which are affected directly or indirectly, for example by the new species reproducing at a higher rate or lacking predators in the new environment. A study conducted in Chile on five mammals and two invasive alien shrubs estimated a minimum annual loss of US$ 87.9 million per year over the past five years. It was concluded that, in the absence of measures to control these seven species, a little over US$ 2 billion would be lost in a 20-year period, calculated on the basis of direct impacts on ecosystem services and the management costs assumed by the State (UNDP, 2017). Unfortunately, Latin America and the Caribbean has developed few capacities to control, eradicate and prevent the introduction of invasive alien species, notwithstanding the fact that some of them are very harmful to numerous sources of work and environmental services.

(b) Indirect drivers

The major changes mentioned in the previous sections that affect ecosystem processes, cycles and functions are based on multifactor social transformations that are considered to be indirect or underlying drivers relating to culture, societal values, economic factors, consumption patterns, population growth, migration, technology, organization and governance (IPBES, 2019). The underlying causes of these changes are determining factors in the decline of natural heritage. If not addressed proactively, it will not be possible to halt biodiversity loss and other concomitant crises by means of reactive solutions alone (for example, developing a vaccine for new diseases, which have increased exponentially) (IPBES, 2020). However, owing to the complexity of addressing them, indirect causes are usually low on the list of priorities and efforts to find solutions and are often not measured systematically, making it difficult to gauge progress and setbacks. This section refers to only a few of these causes.

(i) Cultural drivers

A first obstacle to conserving and sustainably using biodiversity is the general lack of familiarity with its structural role for human well-being. People, economic and productive sectors, organizations and governments need to understand this role in order to garner the political and social will and commitment to support behavioural change (Hesselink and others, 2007). Although raising awareness about the values of biodiversity is the first goal of the Aichi Biodiversity Targets, there has been little progress and statistical monitoring of this issue in the region.

(ii) Institutional and knowledge capabilities

The capacities of environmental institutions are crucial for stopping biodiversity loss. Environmental institutions are relatively recent in Latin America and the Caribbean, and the trend is towards giving the environmental sector higher status. Between 2010 and 2021, 61% of countries made changes to their environmental authorities, mostly to afford them ministerial status or separate them from other portfolios, such as housing and urban planning, to enable ministries of the environment to focus on their core concern (in Uruguay this occurred in 2020). However, the functions relating to this sector still tend to be dispersed across several entities. As a result, their coordination is complex, they have little political power and suffer from large gaps in terms of human resources —with high levels of employee turnover—, technology, infrastructure and financing. Most countries have not completed the full institutional framework with a ministry, vice-ministry or equivalent, environmental evaluation system, environmental justice courts or tribunals, superintendency, environmental prosecutor’s office or attorney’s office, and an institution responsible for biodiversity knowledge. Table IV.2 shows two periods of stronger progress in creating or modifying the institutional structure: (i) the 1990s, encouraged by the United Nations Conference on Environment and Development, and (ii) from 2010 onward. Only seven countries in the region have special institutions devoted to biodiversity. However, these institutions include leaders recognized worldwide as pioneers in compiling, researching, systematizing, curating and generating analytical tools and products and making information available to decision-makers, academics or the public in general, using the corresponding language in each case[1] (Soberón, 2004).

In general, the institutional framework for addressing commitments on climate change is situated in ministries of the environmental, although in practice synergy and transversality is limited. At the local government level, very few municipalities have powers or staff with technical capabilities on environmental issues beyond waste or water management (Cruz-Angón and others, 2016). However, local authorities and communities may be the first to see changes on the ground and will the directly affected by them, so it is important to build their capacities and increase their interaction with other levels of government.

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1 This is the case of the Alexander von Humboldt Biological Resources Research Institute in Colombia, the National Biodiversity Institute (INBio) in Costa Rica and the National Commission for the Knowledge and Use of Biodiversity (CONABIO) in Mexico, which have inspired others countries to create institutions such as the Biodiversity and Environment Research Institute (INIBIOMA) in Argentina, the Biodiversity and Environment Research Centre (CIBIOMA), of the “José Ballivián” Autonomous University in the Plurinational State of Bolivia, ICMBio in Brazil and the National Biodiversity Institute (INABIO) in Ecuador.

Table IV.2

Latin America and the Caribbean (22 countries): period of establishment or change in environmental institutional structure

Country	Institution with ministerial rank (in some countries, called secretariat)					Courts, environmental tribunals and specialized units in another court					Specialized institutions or units for crimes and infractions (attorney's and prosecutor's offices)					Institution for biodiversity (other than the ministry)				
	Before 1980–1989	1980–1989	1990–1999	2000–2009	2010–2021	Before 1980–1989	1980–1989	1990–1999	2000–2009	2010–2021	Before 1980–1989	1980–1989	1990–1999	2000–2009	2010–2021	Before 1980–1989	1980–1989	1990–1999	2000–2009	2010–2021
Antigua and Barbuda					■					■					■					
Argentina	■		■		■					■				■	■			■		
Bolivia (Plurinational State of)				■					■											
Brazil		■		■				■					■						■	
Chile					■					■					■					
Colombia			■		■								■		■			■		
Costa Rica		■			■			■					■				■	■		
Cuba			■															■		
Dominican Republic				■										■						
Ecuador			■		■										■					■
El Salvador			■							■			■		■					
Grenada					■															
Guatemala				■				■					■		■					
Haiti			■																	
Honduras			■										■		■					
Mexico			■	■						■			■	■				■		
Nicaragua			■										■	■						
Panama					■										■					
Paraguay				■	■					■				■						
Peru				■						■				■	■					
Uruguay			■		■															
Venezuela (Bolivarian Republic of)	■				■															

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official and institutional websites, news in online newspapers, academic papers and United Nations Environment Programme (UNEP), *Environmental Courts and Tribunals: A Guide for Policymakers*. Nairobi, 2022.

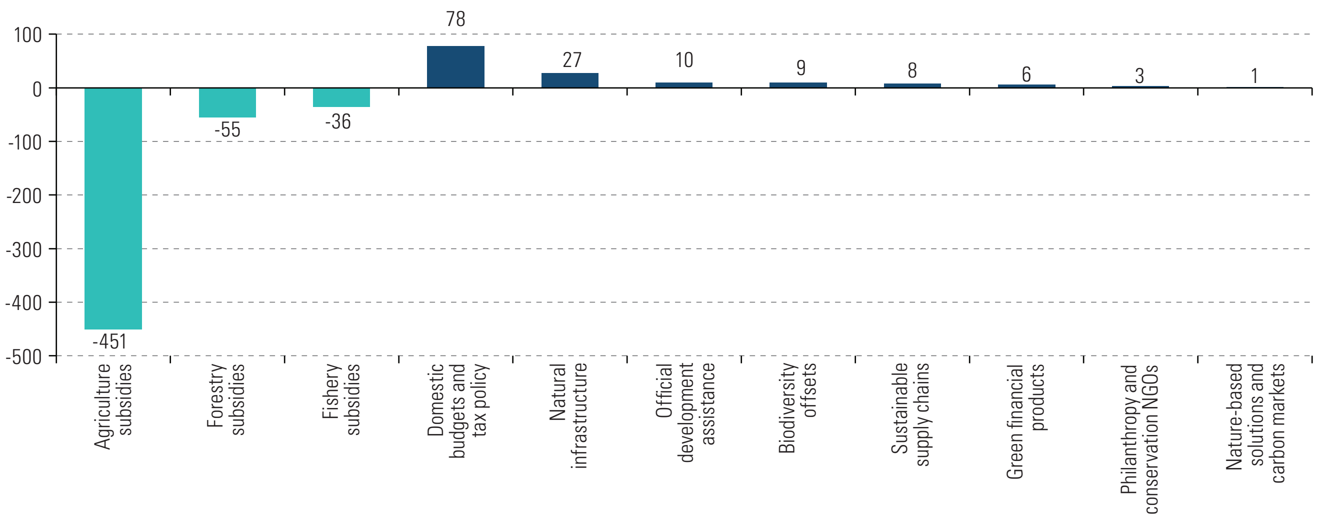
Note: Although it falls outside the period referred to, a notable setback was seen in the case of Mexico, where the National Commission for the Knowledge and Use of Biodiversity (CONABIO), created in 1992 as an intersecretarial commission and whose decentralized model and outcomes were recognized worldwide, was subsumed into the current Secretariat of Environment and Natural Resources (SEMARNAT).

(iii) Economic factors

Latin America and the Caribbean has grown on the back of trade in its natural assets, especially thanks to the commodity price boom between 2000 and 2013. However, much of this growth has not been environmentally sustainable. Costs have not been internalized and the boom periods have not been used to drive innovation, productive diversification and long-term economic growth (ECLAC, 2018) (see box IV.3). The inefficiency produced by incentivizing activities that are harmful to biodiversity is very costly, since it decapitalizes the ecosystem services on which numerous productive activities in the region depend and this, together with other factors, feeds into a vicious cycle of low productivity.

Economic tools that support unsustainable production have a long history, while tools that foster conservation and sustainable use are generally only incipient. Globally, the incentives that are potentially harmful to biodiversity granted by governments (in the order of US$ 500 billion) exceed five- or sixfold the incentives that generate positive impacts (by governments in addition to the proceeds from some international organizations and various areas of the private sector, which are estimated at between US$ 78 billion and US$ 91 billion) (OECD, 2020). Figure IV.6 shows estimates of potentially harmful and beneficial subsidies in the agricultural, forestry and fishing sectors. Few countries have described or evaluated the different types of national supports or incentives that are harmful to biodiversity or the environment in general (Matthews and Karousakis, 2022). This type of analysis is badly needed in Latin America and the Caribbean.

Figure IV.6
Harmful subsidies and global financial flows towards biodiversity conservation, 2019
(Billions of dollars per year)



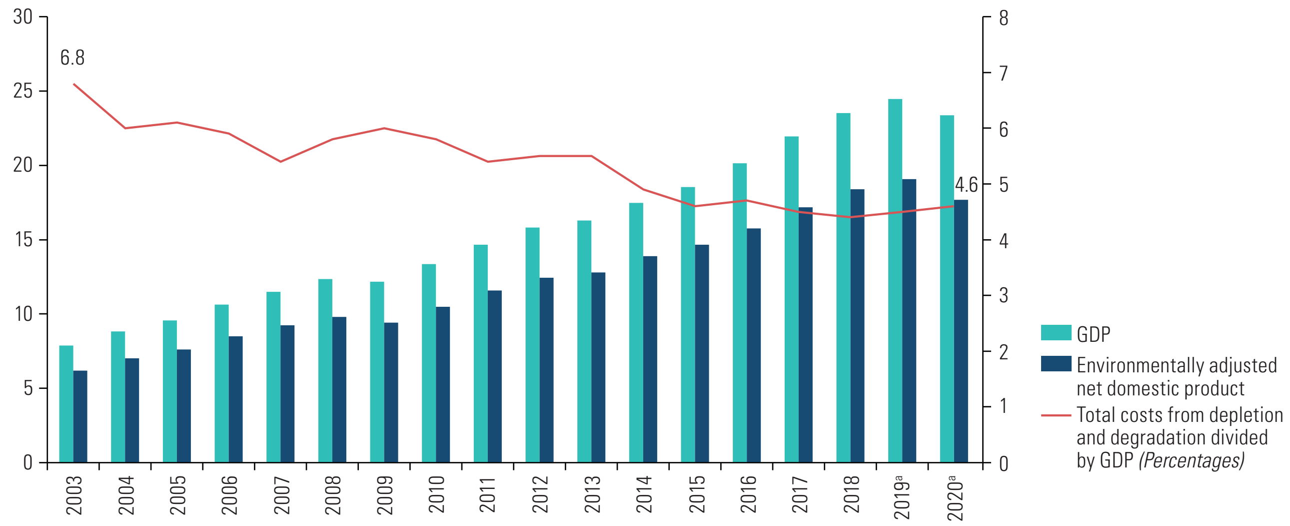
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of A. Deutz and others, *Financing Nature: Closing the Global Biodiversity Financing Gap*, Paulson Institute/The Nature Conservancy/Cornell Atkinson Center for Sustainability, 2020 [online] https://www.paulsoninstitute.org/key-initiatives/financing-nature-report/.

Note: The estimates of agricultural, forestry, and fisheries harmful subsidies correspond to the "potentially harmful to biodiversity" category of production subsidies of the Organisation for Economic Co-operation and Development (OECD). This figure excludes the estimated additional US$ 395 billion–US$ 478 billion in fossil fuel production subsidies.

In the past decade, the risk perception of the loss of biodiversity and ecosystem services, in terms of impact and probability, has increased substantially in the economies included in the World Economic Forum's annual global risk reports. Biodiversity loss began to be perceived as a potential global risk starting with the 2014 reports and since 2018 its estimated risk over a 10-year period has been increasing. In the last four annual reports (from 2020 to 2023) it ranked between the third and four severest risk (WEF, 2014–2023).

The market's failure to incorporate the negative externalities of productive activities is also a broader institutional shortcoming, since governments and their institutions have failed to manage these negative effects (Dasgupta, 2021). Quantifying the degradation could help to shift macro and sectoral economic policies to halt the loss. In Mexico, environmental degradation has been assessed in the national environmental satellite accounts, by incorporating the cost of air, soil and water pollution and waste equivalent to 85.4% of the damage, and the cost of hydrocarbon, groundwater and forest resources depletion, which accounts for the remaining 14.7% (INEGI, n.d.). A decrease in environmental costs was recorded over the period 2003–2020, from 6.8% to 4.6% of GDP. However, environmental damage remains high, exceeding US$ 51 billion[2] (see figure IV.7). Mexico, with the support of the United Nations Statistics Division and the United Nations Environment Programme (UNEP), has been at the forefront of monetary valuation of various ecosystem services such as pollination, carbon sequestration and agricultural production in the experimental ecosystem accounts produced by the National Institute of Statistics and Geography (INEGI, 2021).

Figure IV.7
Mexico: GDP and environmentally adjusted domestic product, 2003–2020
(Trillions of pesos at current prices and percentages of GDP)



Source: National Institute of Statistics and Geography (INEGI), "Economía y Sectores Productivos" [online] https://www.inegi.org.mx/temas/ee/ [accessed in October 2022].
[a] Preliminary data.

(iv) Financial and resource mobilization capabilities

Most studies on financing for biodiversity in the region conclude that resources are insufficient (for example, Castro and others, 2000; World Bank, 2013; Pérez Gil and Arroyo Quiroz, 2016 and BIOFIN Guatemala; 2016). Generally speaking, government spending on sustainable biodiversity management is insufficient to achieve agreed national and international goals. For this reason, the new Kunming-Montreal Global Biodiversity Framework included a specific target aimed at strengthening financial capacities for implementation —target 19— adding to target 18 to eliminate or reform subsidies harmful for biodiversity and to scale up positive incentives (Secretariat of the Convention on Biological Diversity, 2022).

Meanwhile, there are multiple joint initiatives between national and subnational governments and international bodies advocating for green financial instruments to invest, value and measure investment impact, such as debt-for-nature swaps, the

2 At the average dollar exchange rate (20 pesos per dollar) in 2018.

development of methodology to quantify financial flows and green tax reform. Among the programmes that have produced excellent outcomes in some countries in the region, The Economics of Ecosystems and Biodiversity warrants special mention (see box IV.4).

Box IV.4
Brazil and The Economics of Ecosystems and Biodiversity programme

The main objective of the global initiative The Economics of Ecosystems and Biodiversity is to include the value of biodiversity and ecosystem services into decision-making at all levels, through a structured valuation approach that helps decision-makers to recognize the wide range of benefits provided by ecosystems and biodiversity, demonstrating their value in economic terms and capturing those values in decision-making. Since 2014, activities have been carried out under the initiative in Brazil to foster: (i) the development of public land-use planning policies (establishment of ecological-economic zones and municipal management plans); (ii) the development and implementation of economic incentives (payment for environmental services and green public procurement); (iii) the integration of management tools (permits, charges for water and energy concessions, environmental impact, incentives to conserve and protect native vegetation and forest offsets); (iv) the creation of environmental economic accounts (integration of ecosystem services and biodiversity in decision-making at the highest level, for example, the establishment of Brazil's green domestic product by virtue of Law No. 13493 of 17 October 2017); (v) the strengthening of the Brazilian Business and Biodiversity Initiative, which integrates ecosystem services in business management; and (vi) capacity-building through formal higher education programmes for the business sector.

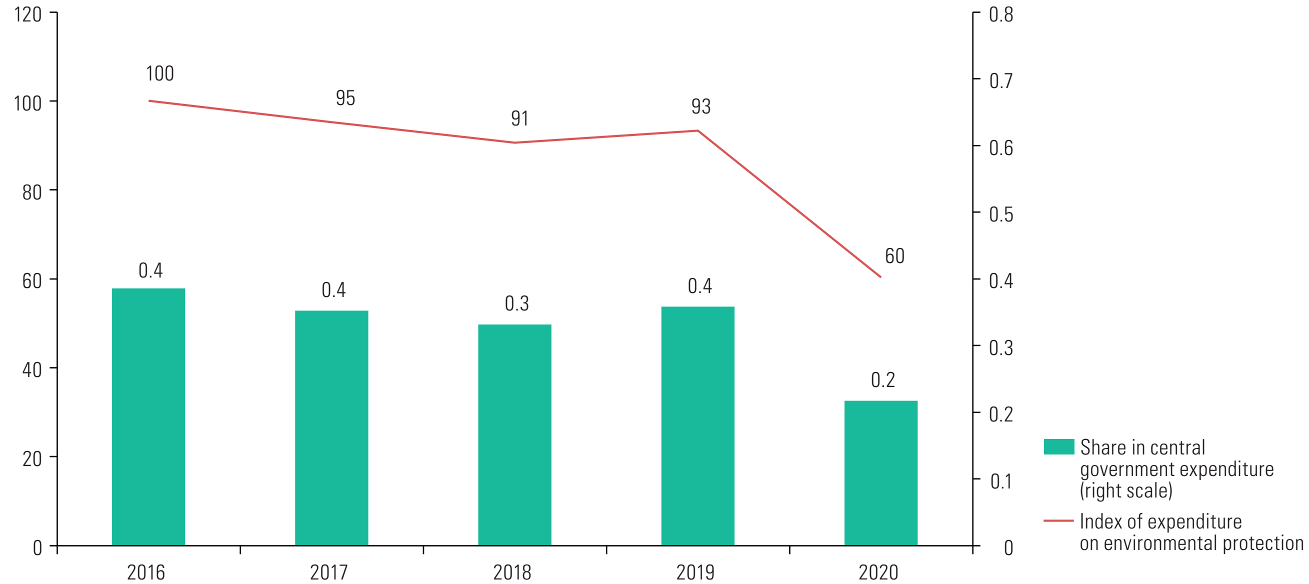
Source: B. F. Dias, "Integraçao de serviços ecossistêmicos em políticas públicas para conservação e uso sustentável da biodiversidade", presentation, May 2019 [online] https://www.researchgate.net/publication/340315587_Integracao_dos_Servicos_Ecossistemicos_em_Politicas_Publicas_para_Conservacao_e_Uso_Sustentavel_da_Biodiversidade_Biodiversidade_e_Servicos_Ecossistemicos_Desafios_e_Oportunidades_para_o_Brasil; The Economics of Ecosystems and Biodiversity (TEEB), "Brazil" [online] http://teebweb.org/where-we-work/americas/brazil/.

The governments of the region have made progress towards providing resources for policies to protect and sustainably use biodiversity in this century, but there have also been notable setbacks and constant budget cuts in recent years. It is a matter of great concern that governments are reducing resource allocations for the environmental sector, amid the economic and social crisis caused by COVID-19. Average spending on environmental protection in 11 countries in the region[3] fell by 35% between 2019 and 2020 compared to 2016, as ECLAC has warned (see figure IV.8) (ECLAC, 2021).

In economic terms, in order to conserve, sustainably use and recoup the natural heritage, investment in biodiversity and its ecosystem services should focus on: (i) use and usufruct and how they are regulated; (ii) the recovery and restoration of critical habitats; (iii) conservation; and (iv) re-directing investment that is harmful to biodiversity. Investment returns are multidimensional, touching on social aspects, human rights, the environment (whether valued or not) and the market economy. The analysis of successful cases in the region shows benefits such as improved revenues and lower inequalities, and the addressing of multiple simultaneous challenges through innovation and resilience (for example, amid COVID-19), capacity development and co-production of knowledge, productive diversification and the increase of value chains, the participation and empowerment of communities and vulnerable groups, multi-stakeholder approaches, intra- and inter-institutional agreements and cooperation, transdisciplinary and multi-channel approaches and territorial adaptation (Alvarado, Tambutti and Rankovic, 2022; Catacora-Vargas and others, 2022). The act of affording dimension and value to integrated returns on investment in sustainable activities is in itself a transformative action.

[3] Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Honduras, Mexico, Peru and Uruguay.

Figure IV.8
Latin America and the Caribbean (11 countries):[a] expenditure on environmental protection, 2016–2020
(Index: 2016=100 and percentages of central government spending)



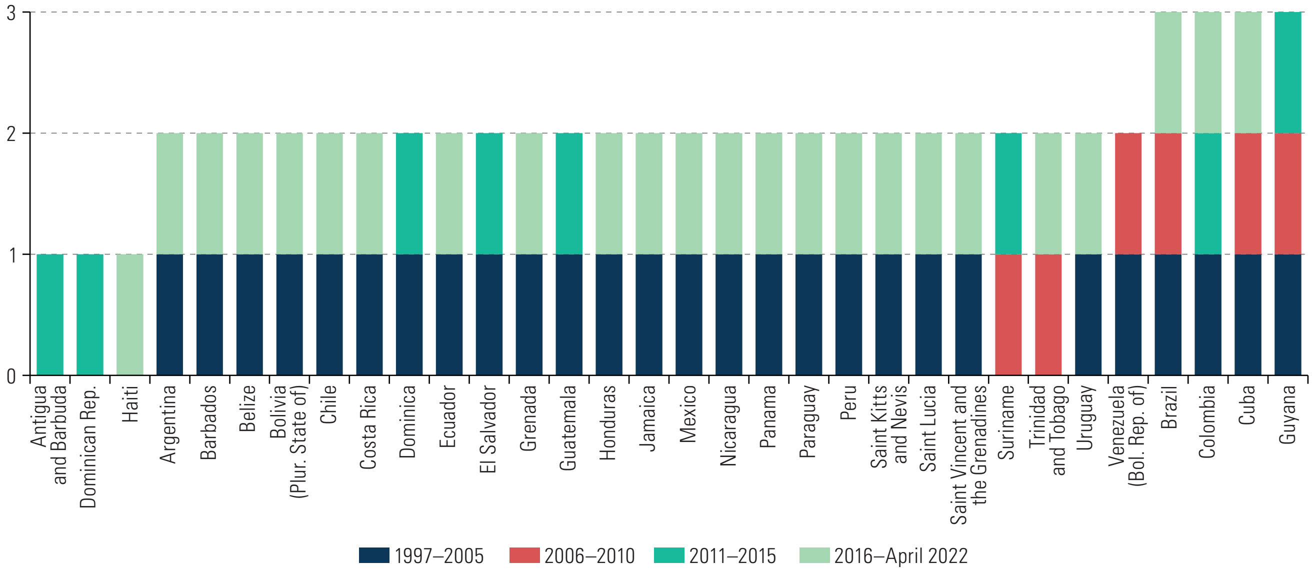
Source: Economic Commission for Latin America and the Caribbean (ECLAC), "The recovery paradox in Latin America and the Caribbean. Growth amid persisting structural problems: inequality, poverty and low investment and productivity", *COVID-19 Special Report*, No. 11, Santiago, 8 July 2021.
[a] Functional information on environmental protection spending in Argentina, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, El Salvador, Honduras, Mexico, Peru and Uruguay.

B. Biodiversity governance

1. Public policies and policy tools

National Biodiversity Strategies and Action Plans are a policy tool derived from an international framework, the Convention on Biological Diversity, which contains objectives and guidelines for integrating biodiversity into the planning in different sectors. All the countries in the region have developed strategies and plans; most (32 countries) did so between 1999 and 2005, 29 have updated their plans and Brazil, Colombia, Cuba and Guyana are on their third version (see figure IV.9). The countries that have not updated these plans are Caribbean countries with fewer resources and more limited institutional capacities. This policy is considered crucial and will have to be updated in the next two years in light of the new commitments made at the second part of the fifteenth meeting of the Conference of the Parties to the Conference of the Parties to the Convention on Biological Diversity in December 2022, for which it was agreed to deliver fast and effective support.

Figure IV.9
Latin America and the Caribbean (32 countries): version of the national biodiversity strategy and action plan, by country and publication period
(Version number)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Secretariat of the Convention on Biological Diversity, "National Biodiversity Strategies and Action Plans (NBSAPs)" [online] https://www.cbd.int/nbsap/about/latest/ and the national strategies and action plans on biodiversity reviewed up to April 2023.

Note: The periods refer to the mandates established for parties in the Convention on Biological Diversity.

(a) Area-based initiatives

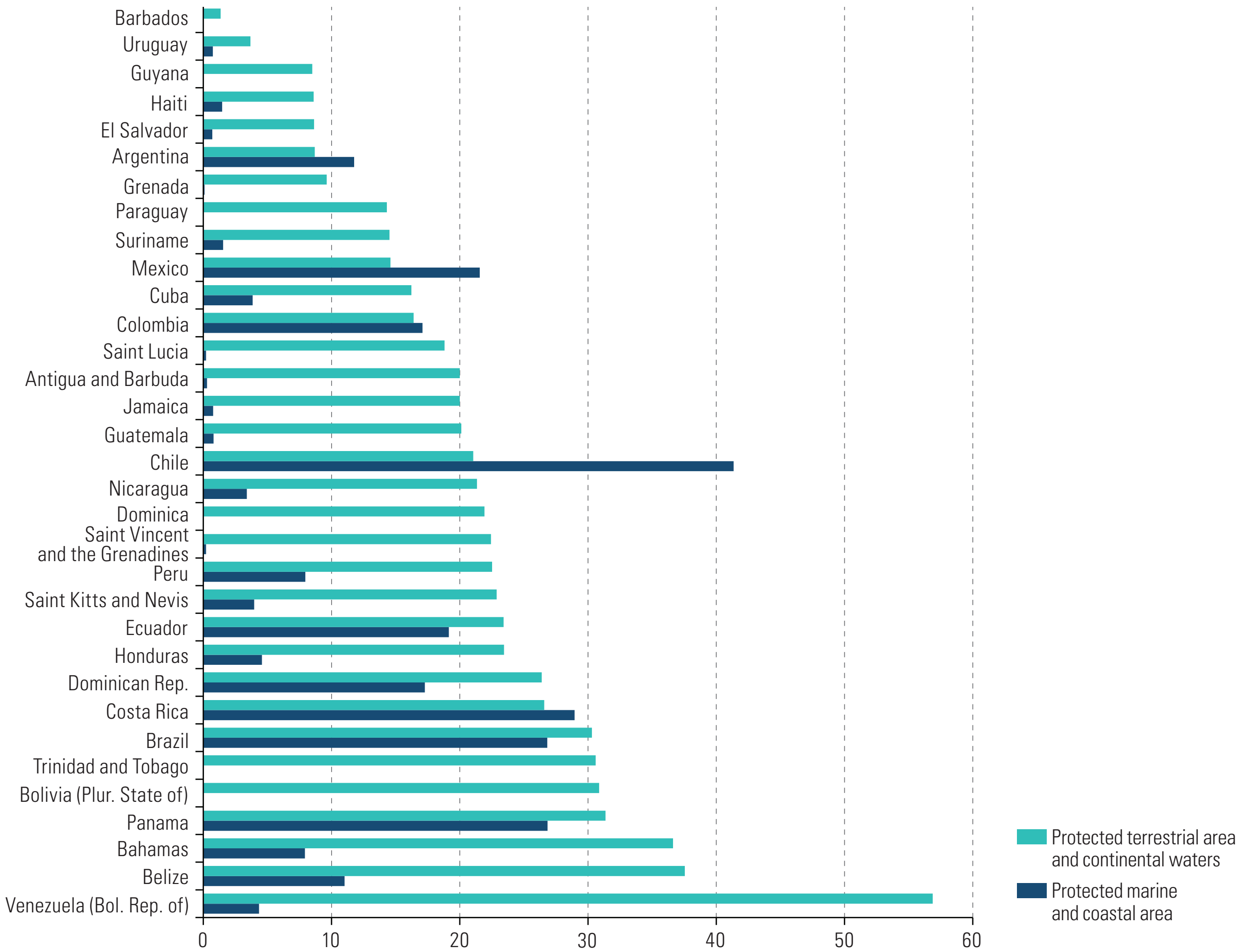
Latin America and the Caribbean have significantly increased protected areas, using different modalities of access, protection and management. Today, the 33 countries in the region have protected just over 24% of their land territories and close to 22% of their marine territory, which exceeds the target area of Sustainable Development Goal (SDG) target 14.5 of the 2030 Agenda of conserving at least 10% of marine areas (WCMC, 2023). However, the new commitments under the Kunming-Montreal Global Biodiversity Framework established, as global target for 2030, that at least 30% of marine ecosystems, 30% of terrestrial ecosystems and 30% of freshwater resources be conserved and managed through ecologically representative, well-connected and equitably governed systems of protected areas and other effective area-based conservation measures, recognizing the territories and rights of Indigenous Peoples and local communities. All this implies that countries must continue to increase their protected or conserved national areas within the framework of sustainable management systems.

In the region, in the case of terrestrial ecosystems, the Bolivarian Republic of Venezuela has more than half of its territory under protection. For their part, the Bahamas, Belize, Brazil, Panama, the Plurinational State of Bolivia, and Trinidad and Tobago have a protected area of over 30%. By contrast, the figure is under 10% in Argentina, Barbados, El Salvador, Grenada, Guyana, Haiti and Uruguay (Aichi target 11 was 17% for 2020). With respect to marine protected areas, the situation is more heterogeneous, since nearly a third of countries with marine territories have reached or exceeded goal 14.5 of the 2030 Agenda (see figure IV.10). Twenty-one countries have less than 10% of their marine territory protected, 11[4] of them less than 1%. Special mention is warranted of

[4] Antigua and Barbuda, Barbados, Dominica, El Salvador, Grenada, Guyana, Jamaica, Saint Lucía, Saint Vincent and the Grenadines, Trinidad and Tobago and Uruguay.

Chile, which protects 41.53% of its exclusive economic zone, and Brazil, Costa Rica and Panama, which protect over 25%. Another challenge in relation to area protection is preparation of management plans for all those already declared and resources for their proper management and surveillance. For example, in the case of Chile, the financing gap has been calculated at 98.3% (WCS, 2018).

Figure IV.10
Latin America and the Caribbean: terrestrial and marine protected areas with respect to their respective land and marine territories, March 2023
(Percentages)



Source: World Conservation Monitoring Centre (WCMC), World Database on Protected Areas [online] www.protectedplanet.net [accessed in March 2023].
Note: Protected terrestrial areas are given in proportion to the respective country's emerged surface area. Marine terrestrial areas are given in proportion to the exclusive economic zone.

Latin America and the Caribbean is a repository of payment for environmental services; per-hectare payment is made to communities or owners of forests or territories to conserve them for a certain period for reasons such as hydrological regulation, carbon absorption, maintenance of biodiversity and landscape value. Costa Rica and Mexico have been pioneers in this approach, with 5 million hectares of forests protected in this manner between them (Moros, Matallana and Beltrán, 2020). Initially, payments for environmental services were confined to ecological objectives, but they gradually came to include social inclusion criteria aimed at increasing equity in access, decision-making and outcomes (for example, encouraging the participation of women, Indigenous communities and informal workers, prioritizing areas with higher poverty rates or fostering the regularization of land ownership). In Colombia, payments for environmental services are made to campesino, Indigenous and Afrodescendent communities and are linked to peace processes and the substitution of illicit crops. In Mexico, almost all of them go to Indigenous communities and a third go to communities living below the poverty line. They have an important gender equity component, but since 2018 the programme in Mexico has suffered serious funding cuts (Moros, Matallana and Beltrán, 2020).

Payments for environmental services have different modalities: centralized at the national level (as in Brazil, Ecuador, Mexico, Peru); decentralized (Colombia, Nicaragua, Plurinational State of Bolivia); public, private and mixed, with payments in cash, in kind or both, among others (Moros, Matallana and Beltrán, 2020). A study by ECLAC and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) showed that in Colombia, payments are channelled through public policy tools from the environmental sector, and also the planning and the foreign relations sectors. In Mexico, payments are managed via the environment sector and, incipiently, the agricultural sector; in Peru only the environment sector is involved (Franco, 2023).

2. Social and private stakeholders

Nature-based solutions, restoration and conversion to green jobs are labour intensive, which speaks to another advantage of regearing economies towards sustainability (Sánchez and Torres, 2020; Sagent, Vogt-Schilb and Luu, 2020). However, the private sector is highly atomized in the field of biodiversity and is not on the agenda of the labour sector; it is rather associated with subsistence and self-employment, as well as micro-, small and medium-sized enterprises (MSMEs). Accordingly, it lacks real possibilities for training and does not usually participate in social dialogue, which are necessary conditions for a sustainable transition (Maffei, 2021). This was confirmed by a detailed study carried out by the Ministry of the Environment of Peru with the support of GIZ, which identified 1,317 biodiversity-friendly companies, of which 76% were MSMEs.[5] Accordingly, unlike in sectors such as hydrocarbons, energy or large-scale mining, here it must be considered that most of the stakeholders, while not large companies, have great employment capacity and should be afforded greater impact on the governance of biodiversity and ecosystem services.

(a) Indigenous Peoples, local communities and sustainability-based management

There is increasing evidence that Indigenous Peoples and local communities in Latin America and the Caribbean play an essential —and virtually unrecognized— role in the stewardship and conservation of biodiversity, as well as in the fight against deforestation (Secretariat of the Convention on Biological Diversity, 2022; FAO/FILAC, 2021; ICCA Consortium, 2021). The region's protected areas have the highest percentage of Indigenous and local community participation in governance systems (9%) in the world, while other regions have less than 3% (WCMC/UICN/NGS, 2018). It has been documented that deforestation is almost three times lower in Indigenous territories in the Plurinational State of Bolivia, 2.5 times lower in Brazil and in Colombia half (FAO/FILAC, 2021). The role of Indigenous Peoples is indispensable, given that they occupy one fifth of the surface area of Latin America and the Caribbean (404 million hectares). More than 80% of the area they occupy is covered with forests and they participate in the communal governance of 320 to 380 million hectares. There is also evidence —although insufficient owing to lack of studies— to suggest that Indigenous

5 Personal communication with GIZ staff responsible for the project "Inversiones de impacto para el uso sostenible de la biodiversidad en Perú (BioInvest)", 27 October 2021.

Peoples and local communities who have property rights over land have been more effective in conserving forests than communities that do not, sometimes even more than in similar protected areas (FAO/FILAC, 2021).

First peoples and local communities are under pressure from changes in land use or violence and invasion. It is regrettable that more opportunities have not been opened to them and they are not formally included in decision-making, which ultimately puts their ways of life at risk. For example, in the past decade less than 1% of financial assistance for climate-change-related issues has supported land tenure and the management of Indigenous and local forests (ICCA Consortium, 2021). To address this situation, the new Kunming-Montreal Global Biodiversity Framework affords them prominent treatment as agents of change.

The region has the highest average tons of biomass per hectare (178 t/ha), 50% more than the world average, which testifies to the quality and biodiversity of its forests (ECLAC, 2022). The region's great forestry endowment can be managed by safeguarding ecosystem services, with native species, and by local communities as part of the comprehensive and biocultural management of the territory. Biocultural products, such as crafts, gastronomy, medicinal use, ecotourism, and so on, should also be strengthened. It is notable that in North and Central America, 96% of forest species are native and 59% of the forest area is included in long-term management plans (Mesoamerica and Mexico have pine diversification centres, a species widely used in plantations), while South America has only 3% native species and 17% under long-term management plans. Both figures are the lowest in the world (FAO, 2020) (see box IV.5).

Box IV.5

Community management of forests in Petén (Guatemala), to achieve the 2030 Agenda

Community management of 533,131 hectares of the Mayan Biosphere Reserve is implemented through 25-year, extendable concessions, extended since 1996 to nine local communities to stop deforestation and the advance of the agricultural frontier in a multiple-use zone of the reserve. They are entrusted with the conservation and sustainable use of timber and non-timber forest resources, tourism and other community forest management activities. Among the main drivers of this project is the signing of the Agreement on a Firm and Lasting Peace of 1996 and the recognition of the right to form communal groups. The initiative has four components: (i) community forest management; (ii) value addition and commercial management; (iii) social investment; and (iv) women and youth. The main outcomes include the protection of 44% of the multiple-use zone; the reduction of burning of forests and deforested areas to less than 0.5% of the concessioned area; the reduction of illegal forestry activities; the generation of employment and training for at least 2,000 people (including women and young people); income generation; reinvestment of profits (up to 30%) in social projects (for example, education, health, housing and local infrastructure) and ecological projects; the gradual inclusion of women, who occupy 40% of executive positions; and contribution to 45 targets of the Sustainable Development Goals (SDGs).

Source: F. Carrera, "Autoevaluación de las concesiones forestales en el Guatemala", Food and Agriculture Organization of the United Nations (FAO), 2018, unpublished; D. Stoian and others, *Forest concessions in Petén, Guatemala: A systematic analysis of the socioeconomic performance of community enterprises in the Maya Biosphere Reserve*, Center for International Forestry Research (CIFOR), 2018; and interviews with members of the Association of Forest Communities of Petén.

(b) Human rights approach, participation and access to information

The provision of good access to free, robust, curated, open data with online services benefits government, industry, academia and wider society, including community groups. It also helps to reduce research costs (avoiding duplications and instead redirecting efforts towards unaddressed topics or territories) and increases possibilities for collective participation and monitoring (WABSI, 2017). With a view to economic, social and environmental resilience, it is also necessary to combat misinformation from individuals and governments and encourage self-organization (WEF, 2020a).

One of the gears of transformative change lies in shifting consumption patterns, across society as a whole. Fortunately, civil society is increasingly concerned and demanding answers on environmental issues on social networks and digital media. Since 2016, 159 million people have supported online biodiversity-related campaigns worldwide (23 million in Brazil alone). In Latin America and the Caribbean, tweets about these issues increased by 136% from 2016 to 2019, making it one of the regions with strongest growth in online activism (EIU, 2021). Many demands are linking consumer preferences with the concerns raised. Globally, Google shopping searches for sustainable products rose by almost 71% between 2016 and 2020 (EIU, 2021).

Seventy-six per cent of the region's countries now have provisions within their general legislation on the environment and access to information to encourage participation, and 60% enable an individual or a group to take actions to defend the environment (ECLAC, n.d.). Latin America and the Caribbean has been a pioneer in establishing a binding regional multilateral treaty, the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement), which guarantee access to timely and reliable environmental information, public participation in decision-making processes and access to justice and protection for defenders. The Agreement entered into force on 22 April 2021 and is crucial for a region that has seen many killings of environmental defenders and a disproportionate number of environmental conflicts in relation to its population.

3. International framework: the 2030 Agenda, the Aichi Targets and the new Kunming-Montreal Global Biodiversity Framework

Multilateral agreements have served as an anchor to enable the countries of the region to develop policies and budgets; nevertheless, it is complex to advance simultaneously across all the commitments made, so it is necessary to engage the whole of government and the whole of society.[6] SDG 15 on terrestrial ecosystems includes 4 of 12 targets whose fulfilment had been planned for the year 2020, but none of which have been met to date. SDG 14 on marine life proposed meeting half of its targets before 2030 (in 2020 and 2025). However, it is one of the Goals with the lowest number of indicators and information available in the region and only target 14.5 (conserve at least 10% of coastal and marine areas) has been achieved. As noted earlier, a WTO agreement was reached on the prohibition of subsidies harmful to fisheries, which would imply the achievement of target 14.6 when implemented. The other targets are still far from being achieved. Among the difficulties in monitoring indicators is the fact that impacts on biodiversity are cumulative, synergistic and non-linear. Furthermore, the ecological disturbance threshold is generally unknown, the length of time of response processes is highly variable and the interrelationship between thresholds is unclear. It is therefore important that countries make it a priority to take steps to agree upon and implement specific, concrete and disaggregated means of measuring progress or setbacks, taking into account the measures differentiated between countries, in order to support a more realistic comparison and evaluation of advances within and beyond the region.

[6] Both terms are used in the Convention on Biological Diversity and included in the Kunming-Montreal Global Biodiversity Framework.

All the Latin American and Caribbean countries are signatories to the Convention on Biological Diversity adopted on 5 June 1992. In 2010, the Strategic Plan for Biodiversity 2011–2020, which includes the Aichi Targets, which established five strategic goals for the year 2020, divided into 20 targets and 60 subtargets. Alarmingly, none of these targets were fully met and progress has been insufficient on the vast majority (Secretariat of the Convention on Biological Diversity, 2020). In December 2022, a new global framework, the Kunming-Montreal Global Biodiversity Framework, was agreed upon for the current decade. It recognizes that it is urgent and necessary to make structural and systemic changes to transform prevailing productive, economic, financial and cultural activities in order to achieve the new targets (Secretariat of the Convention on Biological Diversity, 2022). Worth highlighting is the role attributed to Indigenous Peoples as agents of change, as well as to local communities, women, young people and businesses that commit to evaluating their dependencies and impacts on biodiversity. Society is thus given a greater role in the shift towards more sustainable production and consumption. The Framework also includes a mandate to seek cooperation and synergies with other international accords, such as the Paris Agreement and the 2030 Agenda.

C. Conclusions and recommendations

1. Public sector

States must keep ecosystem services in a good state of conservation and operation for all. Biodiversity and its ecosystem services provide indispensable benefits to people, as well as for national health, security and resilience today and in the future. In July 2022, the United Nations General Assembly recognized the right to a clean, healthy and sustainable environment an inalienable human right.[7] Governments must commit more to ensuring this right for the entire population across their respective countries, especially in the territories of marginalized communities such as Indigenous Peoples. It is possible to recover ecosystem services that have been degraded, if the pressures on them are eased or active steps are taken to restore them.

Due importance must be afforded to the loss of biodiversity owing to indirect and direct causes, from different sectors and starting now. The drivers of biodiversity loss are also those behind other situations, such as climate crises, pollution, health, (in)security and social conflicts, so it is no longer feasible to disregard them. Owing to their complexity, the indirect causes of biodiversity loss and degradation have been less addressed (e.g. institutional failures to measure and reverse harmful incentives and negative externalities). Direct and indirect drivers can be addressed in a strategic, simultaneous and synergistic manner within systems of comprehensive transformational change in the current decade. This is a milestone moment at which structural changes can be undertaken progressively, to leave behind unsustainable systems, in the knowledge that this is a challenge that cannot be avoided or postponed.

A turning point will be reached when the institutional framework becomes more robust and comprehensive, and compliance with the environmental and biodiversity regulatory framework become stronger, both in terms of scope (political power) and in terms of capacities, knowledge and financing, and once a principle of non-regression is established. The environmental sector must play a cross-cutting role to ensure coherent national planning, with support from technical and autonomous institutions that are not exposed to high staff turnover or inexperience. It is recommended to create and strengthen institutions that manage reliable and accessible knowledge interfaces in a

7 Resolution 76/300 of 28 July 2022.

language suitable for multiple stakeholders: environmental justice courts, parliaments, subnational governments, businesses, civil society, farmers, fishers, traditional communities, and so on. It is very important to close regulatory gaps in the allocation of powers and horizontal and vertical integration with different levels of government and the private sector. International frameworks, national strategies and other policies and programmes should be adapted at the local level.

It is essential to invest in the conservation, sustainable use and recovery of biodiversity to foster multidimensional returns. This implies investing in: (i) the sustainable use and usufruct of natural heritage and its regulation; (ii) redirecting harmful investment and increasing positive incentives for biodiversity; (iii) the recovery and restoration of critical habitats; and (iv) the conservation of biodiversity. Returns on investment generate and strengthen social, environmental and economic well-being and human rights, and tend to increase in the long term. For example, they foster regional productivity, encourage productive diversification, secure ecosystem-service-dependent employment and recoup natural heritage. Governments spend several times more on items that lead to biodiversity deterioration than on investment in biodiversity. Reducing this enormous amount would enable ecosystems could recover to a great extent. The urgency of this measure is illustrated by target 18 of the Kunming-Montreal Global Biodiversity Framework, the only one set for earlier than 2030, which aims to identify by 2025 harmful incentives for biodiversity, so that they can be eliminated, phased out or reformed, while scaling up positive incentives. This will contribute to obtaining a positive balance with a view to advancing the transition towards sustainability with inclusive and just transition approaches.

The State has the opportunity and the responsibility to contribute to transforming challenges into opportunities, in its role as regulator and lever f comprehensive, coherent and progressive structural changes in coordination with all stakeholders, but this needs clear political will and commitment. National and subnational governments face the challenge of creating the regulations and conditions needed to strengthen the participation and organization of private entities and civil society, producers, community members and others, by fostering the democratic and effective governance of natural resources, as well as clear and transparent rules with regular accountability. In particular, the State must involve the ministries of finance and planning in this process.

It is unrealistic to expect significant change to come from few transformations. It is necessary to generate systems of coherent and articulated changes between different stakeholders and at different scales. There are many tools and policies that can be implemented now, investing time and human capital to advance real harmonization. The mainstreaming of biodiversity into other sectors, the alignment of policies and internal coordination and between sectors and stakeholders are cornerstones in the move towards sustainable systems. They are continuous processes that must be underpinned by political and social will because they imply profound cultural changes in the productive activities on which all of humanity depends. The results of initial regular evaluations must be built into strategies and policies as a key to the transition. Indicators and evaluations of the impact of biodiversity on employment must also be developed.

A priority to right the course lies in measuring the negative effects of production and the economy, in addition to integrating biodiversity in statistics and national accounts. From an economic and social point of view, the region loses out by exporting goods to developed countries without factoring in the negative externalities that, conversely, accumulate in the region. But these global imbalances can be changed. For example, the European Union set a target for this decade of importing only inputs that have not caused deforestation.

It is urgent to implement multiple area-based tools for conservation and sustainable use, using a comprehensive landscape vision that captures complementarity and local biocultural wealth and is built into development planning. There is a wide variety of such instruments, such as payment for environmental services, nature-based solutions, ecosystem-based adaptation to climate change, restoration, blue and green infrastructure, land- or sea-use planning, the establishment of protected areas, guaranteed government purchase of a portion of local producers' sales, among others. Especially at the current stage of recovery from COVID-19, such tools could catalyse investment and decent employment and would produce health benefits for people and ecosystems. This would benefit large segments of society and not just a limited group. For example, cost-benefit calculations for oceans show that sustainable ocean-based interventions can triple investment in mangroves and increase sustainable food production tenfold over a 30-year horizon (Konar and Ding, 2020).

2. Private stakeholders

There is increasing consensus among experts in the region regarding the need to transform the financial system by mainstreaming the value of biodiversity and the risks relating to its loss into capital market regulations to prompt systemic changes. Central and development banks have a key and rapidly developing role, for example, in the development of environmental and climate taxonomies. Capacities are needed to form plans, incentives and financial instruments, incubators and accelerators to foster biodiversity and increase credits to companies that make sustainable use of natural resources. In this regard, special consideration must be given to supporting MSMEs, which generate a large share of employment but have fewer capacities.

It is crucial to increase and strengthen consumers' capabilities to influence sustainable markets (for example, through labelling and traceability). States can drive this change in collaboration with the private sector; in this regard, a turning point may be reached with understanding of all the stages of value chains, the visualization of all its actors in full cycles, as well as the technical collaboration needed to establish measurable goals in the short and medium terms for each of them.

Affording women, Indigenous Peoples and local communities or cooperatives the exclusive use of resources and land tenure for sustainable management has proven to be an excellent tool to reduce inequality, halt biodiversity loss, advance inclusion and obtain shared benefits; it also ties in closely with the human rights agenda.

It is important to provide good access to open, free, robust and curated biodiversity and environmental data, addressing information inequalities, in order to benefit governments, industry, academia and society in general, including community groups. This tends to drive technological innovation and the co-production of knowledge (including traditional knowledge) and fosters a common vision around multidimensional development. Although there is a digital divide that must be addressed, today smartphones already provide a base for digital access that can be leveraged to generate and share information, which in turn balances the concentration of power. Increasing technological innovation and knowledge co-production recognizing traditional knowledge is a crucial path in the region. Reliable and robust biodiversity information systems could move towards incorporating data from multiple reporting systems to the State that are consistent, as long as they are evaluated similarly to citizen science systems, to enable resources to be redirected towards the knowledge gaps that stand in the way of the sustainable transition.

3. International sphere

Progress must be made in coordinating and achieving real reciprocal coherence between different international agreements. Treaties must be fully implemented if they are not to be dead letters. The lesson is that responding to crises reactively is much more costly than preventing them. Accordingly, maximum efforts must be made to ensure coherence, coordination, synergy and simplification between different multilateral agreements. Enough agreements have been adopted today to implement changes, but synergies are hard to achieve as not all parties have the topics integrated to the same degree.

The Kunming-Montreal Global Biodiversity Framework, agreed to in December 2022, should be put into practice rapidly. The framework recognizes the urgent need to transform prevailing productive, economic, financial and cultural activities to achieve the new targets. It is closely linked with the 2030 Agenda and recognizes the role as agents of change played by of Indigenous Peoples and local communities, women, young people and businesses that transparently disclose their dependencies and impacts on biodiversity, affording citizens a greater role in the shift towards more sustainable consumption. In the short term, national biodiversity strategies and their action plans need to be updated in this new framework.

Countries should adhere to the Escazú Agreement, which has been in force since April 2021 and guarantees access to timely and reliable environmental information, public participation in decision-making, and access to justice and protection of environmental human rights defenders. Implementation of the Escazú Agreement is crucial for this region, which is the most dangerous in the world for environmental defenders and suffers from major gaps in terms of the enjoyment of environmental access rights, especially in the case of vulnerable individuals and groups.

Countries need to agree upon and implement concrete and disaggregated ways of measuring progress or setbacks to support more realistic comparison between and within regions, considering the measures implemented differently from one country to another. In this regard, development indices other than GDP should be fostered, incorporating environmental parameters. A good step in this direction is the methodology proposed by the United Nations Statistics Division for the development of ecosystem accounts.

Lastly, it is important to systematize and share experiences and foster peer learning. South-South cooperation on biodiversity has the potential to drive a leap forward in understanding of how to scale up local experiences and projects and position the region at the vanguard of the transition towards comprehensive systems of transformative change for sustainability. Latin America and the Caribbean has numerous experiences of nature-friendly management in different ecosystems and cultures, which it can bring to the table to share with other world regions.

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CHAPTER

V

The bioeconomy and the agroecological transition: sustainability, diversification and value added in agriculture

Introduction

A. Overview and recent trends

B. The bioeconomy: a new production paradigm for the development of agriculture and rural areas

C. Institutions, policies and governance

Bibliography

Introduction

Agriculture fulfils many different functions in society.[1] It is a source of employment and income, and it provides the livelihoods of large sectors of the population, especially in rural areas. It is a fundamental factor in determining food security because of its role in food production. It is also the source of fibres and other non-food products that are part of other value chains in the manufacturing and energy sectors. Its exports also serve as a source of foreign exchange. Clearly, then, agriculture must figure as an essential component of any regional strategy for deriving value from natural resources.

Agriculture is a biologically based production activity entailing the use of the ecosystem services rendered primarily by water, soil, forests and pollinators. As a production activity, it gives rise to externalities that may enhance or diminish the quality of those services; as a biological activity, it is both a carbon sink and a source of carbon dioxide. The agricultural sector can therefore play a central role in the sustainable use of the natural resources that underpin it and in the implementation of climate action strategies.

The uses of natural resources in the agricultural sector are determined by sociocultural, economic and technological factors. Together with geographical conditions, these factors shape a variety of production systems (including subsistence farming and market-oriented systems) and linkages with other sectors, including both backward linkages (as in the case of seed and other agricultural input suppliers) and forward linkages (as in processing and manufacturing activities). Agriculture's place in society is based on both the activities involved in the food system (production, processing and packaging, food distribution and consumption, and waste disposal) and their results (food security, environmental security and social well-being). These factors engender different production models that have different outcomes in terms of job creation, income distribution and their contributions to local and national development.

This chapter is divided into three sections. The first provides a general overview and looks at various environmental and production trends. The second focuses on the bioeconomy as a new paradigm for responding to those trends and for moving towards a more sustainable and more diversified type of agriculture that will add greater value. The third and final section sets forth a number of considerations concerning the sector's institutional structure, policies and governance in the light of the challenges posed by the effects of the coronavirus disease (COVID-19) pandemic and the conflict between the Russian Federation and Ukraine.

The bioeconomy is seen as a response to the need to rethink the future of agriculture in the region. There are structural challenges, however, in at least two domains. First, there are the challenges associated with the characteristics of the production model, which are expressed in the ways that land is used and in greenhouse gas emissions. Second, in terms of the development of the agricultural production sector, there is the challenge posed by the fact that, while the region is, on average, a net exporter of agricultural products, those exports are still concentrated in a few low-value-added commodities. New challenges are also being posed by global environmental changes (e.g. climate change, biodiversity loss, and the fragmentation and deterioration of the world's ecosystems), new types of consumer demand (e.g. the demand for more healthful, safer, more nutritious foods that are produced in a more sustainable way), the effects of the COVID-19 pandemic, and the conflict between the Russian Federation and Ukraine. Meanwhile, advances in the biological sciences and digitalization are opening up new development opportunities for the sector and its associated value chains.

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1 The agricultural sector is defined as encompassing biologically based primary production, which includes crop farming, stock raising, forestry, fisheries and aquaculture. In this chapter, however, the term refers only to crop farming and livestock production.

As a technological and economic model, the bioeconomy provides a variety of ways for taking on those challenges, for example: (i) as one way of addressing climate change, improvements can be made in the carbon sinks, such as forests, soil and the seas, associated with primary production activities; (ii) in order to combat the negative environmental impacts of the use of synthetic nitrogen fertilizers and of increased nitrous oxide (N_2O) emissions, biofertilizers and other biologically based inputs can be developed that will also help to reduce the region's dependency on imports of synthetic fertilizers; (iii) given the prominence of livestock, and especially cattle, as a source of N_2O and methane (CH_4) emissions, more digestible pasturage and fodder can be developed and genetic modifications can be used to improve methanogenesis; (iv) the negative externalities associated with the increase in agricultural waste (including manure) can be seen as an opportunity for the production of bioenergy and biomaterials, along with other high-value-added bioproducts; and (v) changes in consumer habits open up opportunities for diversifying production and developing products that add more value, such as new proteins and food products that are more nutritious and have a better taste and texture.

This bioeconomic approach can transform the conventional view of the relationships between agriculture and food, as well as their relationship to industry. The construct of the bioeconomy goes beyond approaches based on dichotomic options, such as a choice between agriculture and manufacturing or between commodities and manufactures, to open up pathways to economic and social progress. In order to move beyond these conventional approaches, the bioeconomy can draw upon the potential of biological resources as a basis for devising productive development strategies. The development of the bioeconomy can also reshape the region's role in the global economy so that it can move away from its present position as an exporter of a limited number of raw materials and commodities with little value added.

Lastly, the bioeconomy can serve as a pathway to greater sustainability, diversification and value added in agriculture by transforming the sector and capitalizing on advances in such fields as biotechnology, genomics, digital engineering, artificial intelligence, big data management and cloud computing. This can also help to improve perceptions regarding innovation in agriculture and to direct attention towards research, development and innovation in bioprocesses, genomics and the development of new biologically based products.

A. Overview and recent trends

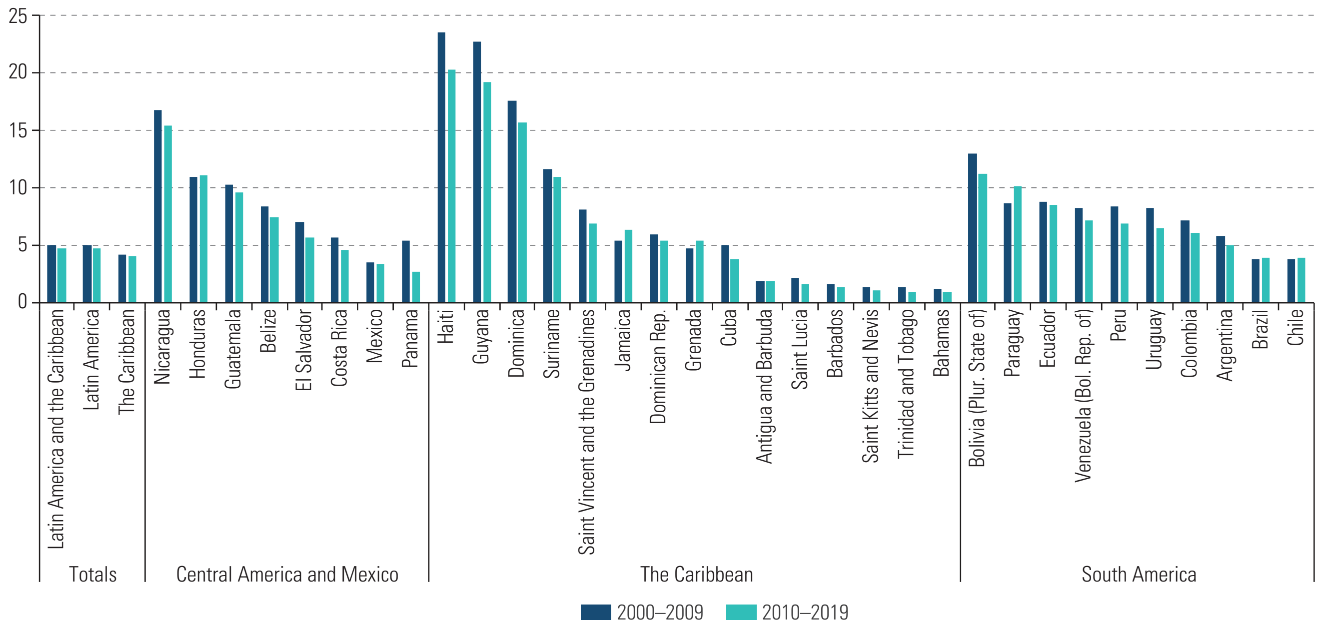
1. Economic importance of agriculture

Agriculture makes a major contribution to the economy of Latin America and the Caribbean: it accounts for 4.7% of the region's GDP, 15% of total employment and 22% of total exports in terms of value. Over the past two decades, its share of global exports has expanded, but its contribution to GDP and to employment has diminished in line with the direction in which structural changes are headed.

(a) Contribution to value added

During the 2010s, agriculture accounted, on average, for 4.7% of the region's GDP, although the figure differed sharply across countries (see figure V.1). At one end of the spectrum, it represented 20.4% of GDP in Haiti and, at the other, 0.9% of GDP for the Bahamas. The sharpest contrasts were seen in the Caribbean, as three of the four countries in which the contribution of agriculture to GDP exceeded 15% (Haiti, Guyana and Dominica) are in that subregion, as are all the countries in which the sector's contribution was below 2%. Other countries in which agriculture provided more than 10% of GDP were Nicaragua (15.4%), the Plurinational State of Bolivia (11.3%) Honduras (11.1%), Suriname (11.0%) and Paraguay (10.1%). Between the 2000s and the 2010s, the portion of GDP represented by agriculture climbed in Paraguay (from 8.6% to 10.1%), Jamaica (from 5.4% to 6.3%), Grenada (from 4.6% to 5.4%) Honduras (from 11.0% to 11.1%), Brazil (from 3.8% to 3.9%) and Chile (from 3.8% to 3.9%).

Figure V.1
Latin America and the Caribbean: contribution of agriculture to GDP, by country, 2000–2009 and 2010–2019
(Percentages)



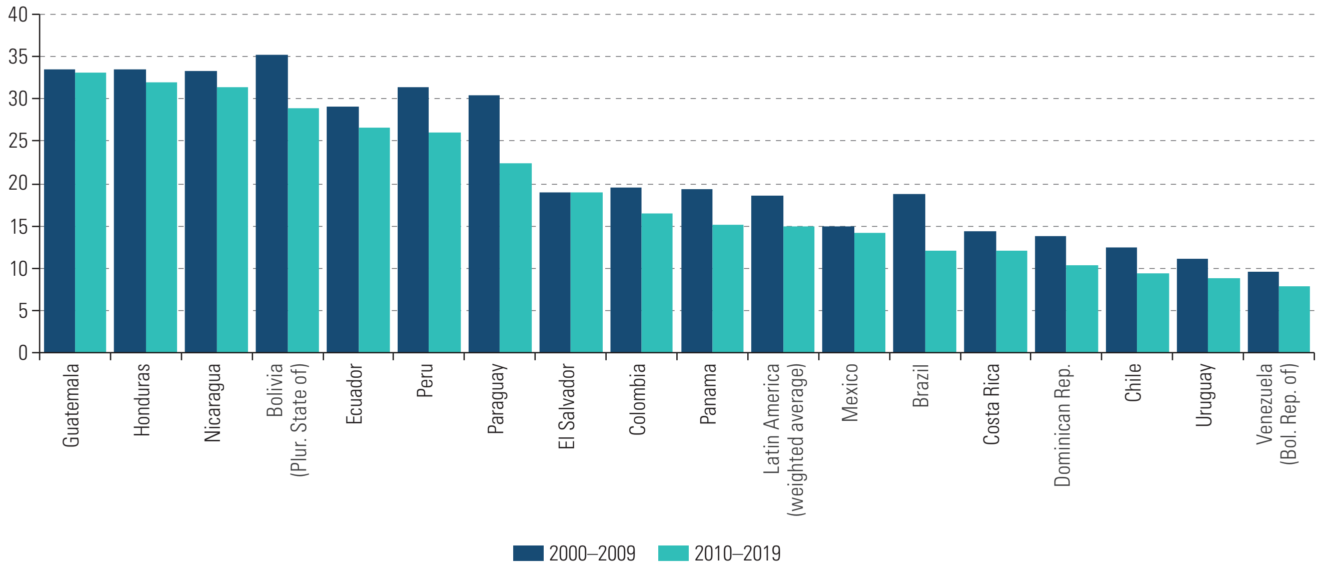
Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en.

(b) Share of the labour market

During the 2010s, the agricultural sector employed 15% of the total workforce, which was 3.7 percentage points lower than the corresponding figure for the preceding decade (see figure V.2). Its share of the employed workforce was thus slightly more than three times greater than its share of GDP (4.7%). The countries in which the sector employed more than 25% of the total workforce were in Central America (Guatemala, Honduras and Nicaragua) and the Andean subregion (Ecuador, Peru and the Plurinational State of Bolivia).

The economically active population in the rural areas of Latin America and the Caribbean is estimated at nearly 50 million people, a majority (53%) of whom work in the agricultural sector, and a large percentage of the persons employed in that sector are own-account or unpaid family workers, especially in the Andean subregion. Own-account and unpaid family workers, most of whom work on family farms (although the definitions vary from country to country), have the lowest incomes of any of the categories of rural workers. The informality and seasonality of so much of agricultural employment are some of the factors that hamper efforts to expand the coverage of the countries' social security systems.

Figure V.2
Latin America and the Caribbean (17 countries): contribution of agriculture to total employment, by country, 2000–2009 and 2010–2019
(Percentages)



Source: Prepared by the authors, on the basis of Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en.

(c) Share of international trade in agricultural products and contribution to global food security[2]

The Latin American and Caribbean region makes a significant contribution to global food security, since it is the largest net food exporter of all the world regions. In order to be food-secure, a person needs to have around 250 kg of foodstuffs per year, and the region has the potential to supply that amount of food to some 2 billion people. At a time when poverty and food insecurity are on the rise, not only in the region but around the world, that figure is significant.

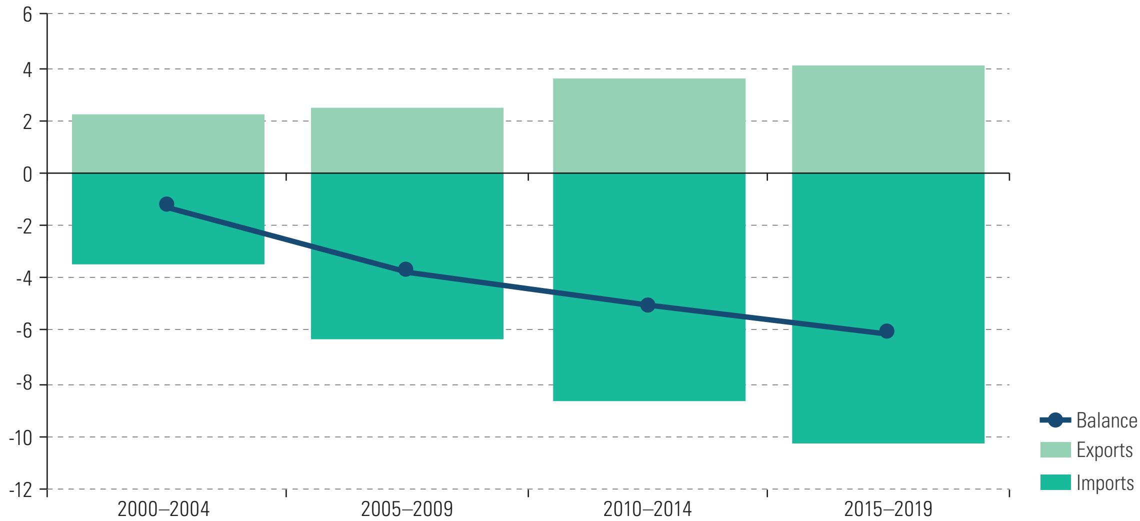
There are stark differences across the various subregions, however. The regional aggregate is largely a result of production in Brazil, Paraguay and the Southern Cone (Argentina, Chile and Uruguay), which are the region's largest exporters of agricultural goods (see figure V.3). Central America and Mexico and the Andean subregion became net exporters in the mid-2010s, but the Caribbean is running an increasingly large deficit in agricultural trade. All the South American countries except the Bolivarian Republic of Venezuela have surpluses on their agricultural trade balances, but the only countries in the subregion of Central America and Mexico that register surpluses are El Salvador and Panama, and Guyana is the only Caribbean country that does so.

Between 2000 and 2020, the contribution of Latin America and the Caribbean to total world exports of farm produce and livestock products rose by nearly three percentage points and has held steady at around 15% since 2010. The value of those exports is equivalent to half the value of the region's total agricultural output (ECLAC, 2023c).

2 For more detailed information on these topics, see ECLAC/FAO (2020) and ECLAC/FAO/WFP (2022).

Figure V.3
Latin America and the Caribbean: agricultural trade balance, by subregion, 2000–2019
(Billions of dollars)[a]

D. The Caribbean



Source: Prepared by the authors on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

[a] Averages for each five-year period.

Agriculture represents 22% of the value of the region's total exports, and that percentage has been on the rise since the turn of the century. At the national level, the agricultural sector's share of total exports ranges from less than 5% (in, for example, Suriname and Trinidad and Tobago) to over 50% (as in Argentina, Ecuador, Honduras, Paraguay and Uruguay). It has also been one of the sectors that has weathered the impact of the COVID-19 pandemic most successfully. In 2020, agricultural trade was up by 2.8% over its 2019 level, whereas trade in products of all the other sectors fell by 7.4% (ECLAC/FAO, 2020; ECLAC/FAO/WFP, 2022).

The region's agricultural exports are concentrated in just a few commodities and their degree of concentration has been increasing. In the 2000s, according to the Food and Agriculture Organization of the United Nations (FAO) (2023), only 15 products accounted for 60% of the total value of the region's agricultural exports (as compared to 35 at the international level), and that number fell to 13 in the 2010s (compared to 39 at the international level). The degree of concentration is even greater when exports are analysed in terms of volume; in the 2000s, just 6 products represented 60% of the total volume (compared to 19 at the international level) and, in the 2010s, that number dropped to only 4 (again compared to 19 at the international level). The predominance of soybean products is remarkable. In the past decade, soybeans, soybean meal and soybean oil accounted for 26% of the total value of agricultural exports and 39% of their total volume.

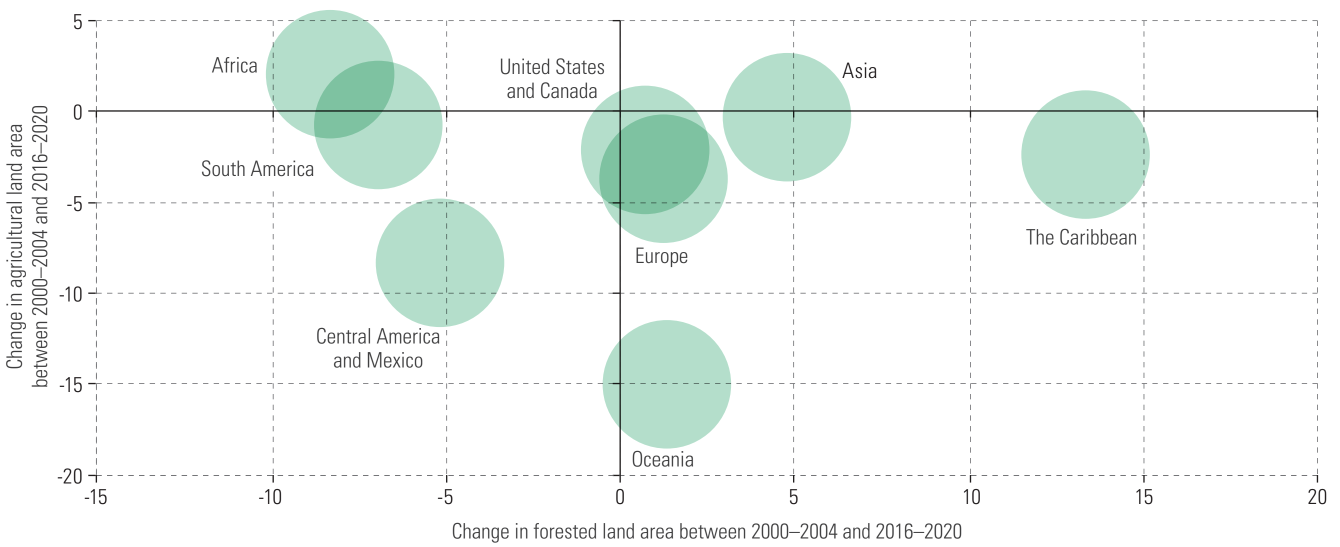
2. Agriculture and natural resources

In 2022, the Latin American and Caribbean region was home to 8.4% of the world's population but only 4% of the world's rural population (FAO, 2023). Its endowment of agriculturally useful natural resources is much greater, however. The region possesses 16% of the world's farmland (FAO, 2023), 33% of the arable land not currently under production (Deininger and Byerlee, 2012), 23% of all forested areas (FAO, 2023), between 40% and 60% of the planet's biodiversity and around 30% of the world's freshwater resources (see the chapter on water resources). Challenges for the region include expanding agricultural output, using resources more efficiently, reducing the sector's environmental footprint (including, for example, its water and carbon footprints) and coping with the ways in which the global environment is changing (e.g. climate change and biodiversity loss and degradation).

(a) Land use and its changes

Land use worldwide has not changed significantly in the past two decades: around 37% of land has been used for agriculture, 31% for forestry and the remaining 32% for other activities (FAO, 2023). At the regional level, however, major changes have been taking place: the percentage of forested land has shrunk in Africa, in South America and in Central America and Mexico, whereas just the opposite has happened in Europe. The relationship between agricultural use and forestry during this century is illustrated in figure V.4.

Figure V.4
Changes in the use of land for forestry and agriculture in the world, by region and subregion, 2000–2004 and 2016–2020
(Percentages)

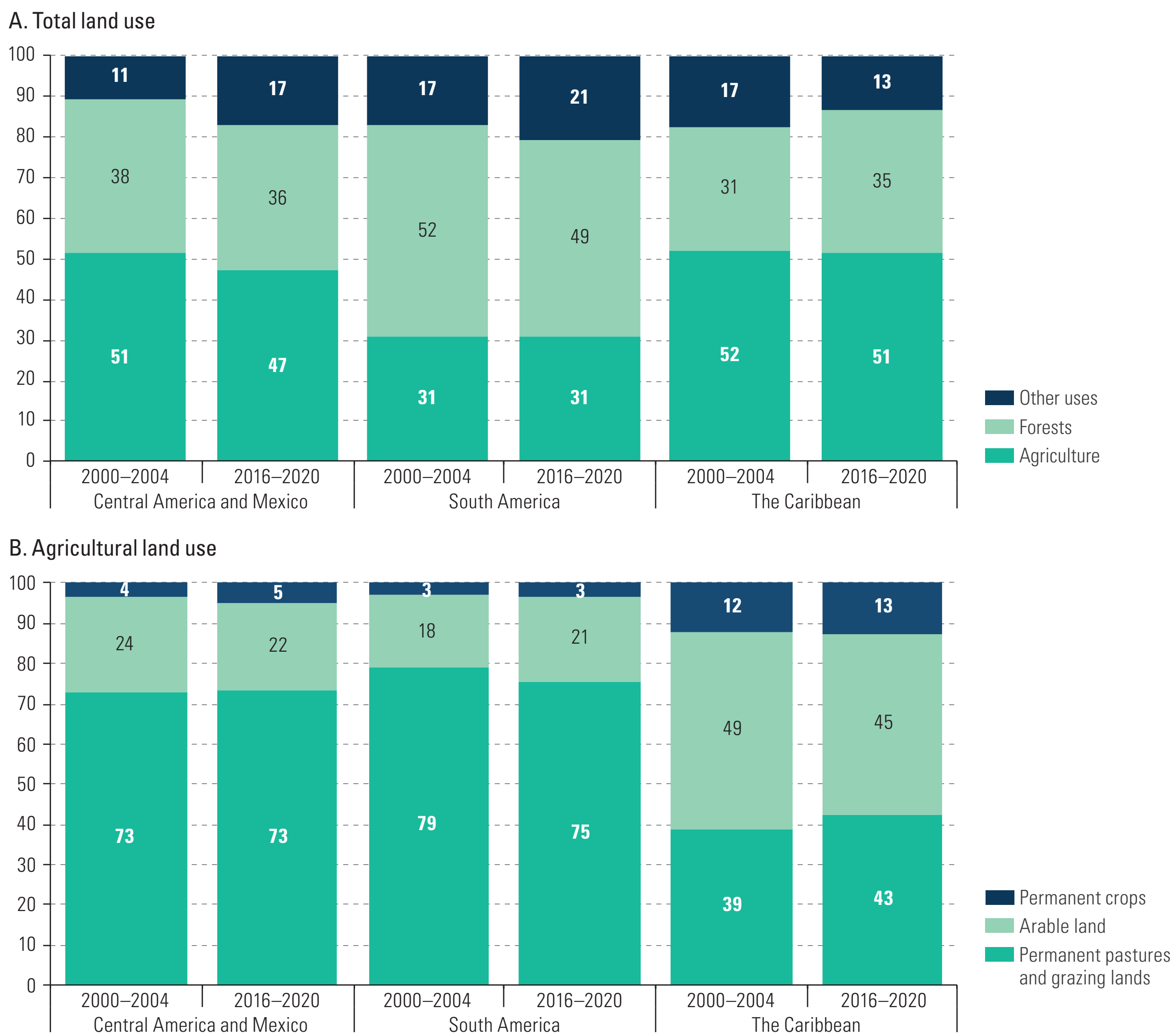


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

In Latin America and the Caribbean, changes in land use patterns have differed from one subregion to another. In the Caribbean, the amount of forested land increased, and agricultural land use declined, whereas, in South America, the amount of forested land decreased (see figure V.5). The trend in agricultural land use in South America has largely been a result of the expansion of soybean crops, while, in the Caribbean, a reduction in the cultivation of sugar cane was a major factor in the subregional trend in agricultural land use. In Central America and Mexico, agricultural land use decreased, and there was a shift in the distribution of land used for forestry and for other uses.

Trends in the distribution of different types of agricultural uses have also varied across the subregions. In South America, as the cultivation of annual crops, such as soybeans, has expanded and stock-raising has declined, there has been a steady increase in the percentage of agricultural land used for crops and a decrease in the land area of pastures and meadows. In Central America and Mexico, there has been a slight increase in the percentage of land used to grow permanent crops. Meanwhile, in the Caribbean, the percentage of cropland has fallen, while the land area devoted to pasturage has increased (see figure V.5).

Figure V.5
Latin America and the Caribbean: total land use and agricultural land use, by subregion, 2000–2004 and 2016–2020
(Percentages)



Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

The rate of deforestation was the highest in the 1990s and 2000s (5.1% and 5.2%, respectively) (FAO, 2020a), with nearly 70% of the deforestation occurring in Latin America in the 2000s being attributable to commercial agricultural activity (FAO, 2016). In the Amazon Basin, agricultural production for export to international markets (e.g. extensive grazing systems, soybean cultivation, palm plantations) has been the main cause of the deforestation occurring in the late twentieth and early twenty-first centuries (Rudel and others, 2009).

In the 2010s, the average amount of primary forest lost per year was substantially smaller than it had been in the preceding 20 years, however. In South America, for example, at 2.6%, the annual rate of deforestation during that decade was just half of what it had been in the 2000s (5.2%) and 1990s (5.1%). This decrease was primarily accounted for by the reduction in deforestation in Brazil, where the average amount of primary forestland lost each year rose from 1.41 million hectares in the 1990s to 2.08 million hectares in the 2000s but then fell steeply to 201,000 hectares in the 2010s (FAO, 2020a).

(b) Soil degradation and variability in the water supply

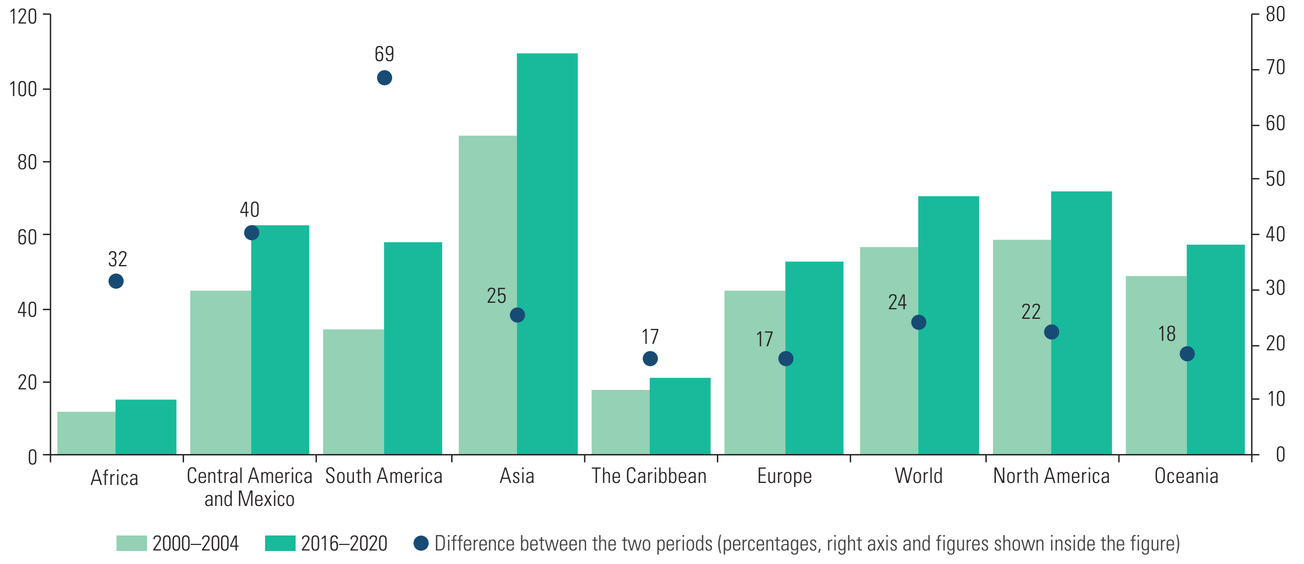
Projections for 2050 point to a growing shortage of agriculturally relevant natural resources, whether due to environmental degradation (e.g. soil degradation) or to competing land uses. According to data compiled by FAO (2017), more than one third of the world's agricultural land is moderately to seriously degraded, and there are few opportunities left for further expanding the land area devoted to agriculture. It is estimated that the rate of soil erosion in agricultural fields is currently 10 to 20 times higher for untilled land than the rate of soil formation and that it is more than 100 times higher than the soil formation rate for land on which conventional tillage systems are being used (IPCC, 2019).

The per capita endowment of water resources in Latin America is four times greater than the world average, but the distribution of those resources is very uneven. As agricultural irrigation accounts for nearly 70% of total water extraction, the use of technologically sophisticated irrigation systems is key for the development of the agricultural sector and for the environmental sustainability of the planet.

(c) Use of synthetic nitrogen fertilizers

The heavy use of synthetic nitrogen fertilizers is the main source of the agricultural sector's nitrous oxide (N_2O) emissions, and this input's use has become more intensive in every region of the world over the past two decades (see figure V.6). The steepest increase occurred in South America (69%), where the intensiveness of its use jumped from 34 kg ha^{-1} in the period 2000–2004 to 58 kg ha^{-1} in the period 2016–2020. From 2000 to 2004, that subregion's intensity rate was the third lowest in the world, after the rates of the Caribbean and Africa. Most of the synthetic fertilizers used in the region are imported. From 2000 to 2002, a full 70% of all synthetic nitrogen fertilizers used in South America were imported, but by the period 2017–2019, that figure had risen to 95% (CEPAL/FAO/WPA, 2022; ECLAC, 2022).

Figure V.6
Use of nitrogen fertilizers worldwide, by region and subregion, 2000–2004 and 2016–2020
(Kilograms per hectare of cropland and percentages)



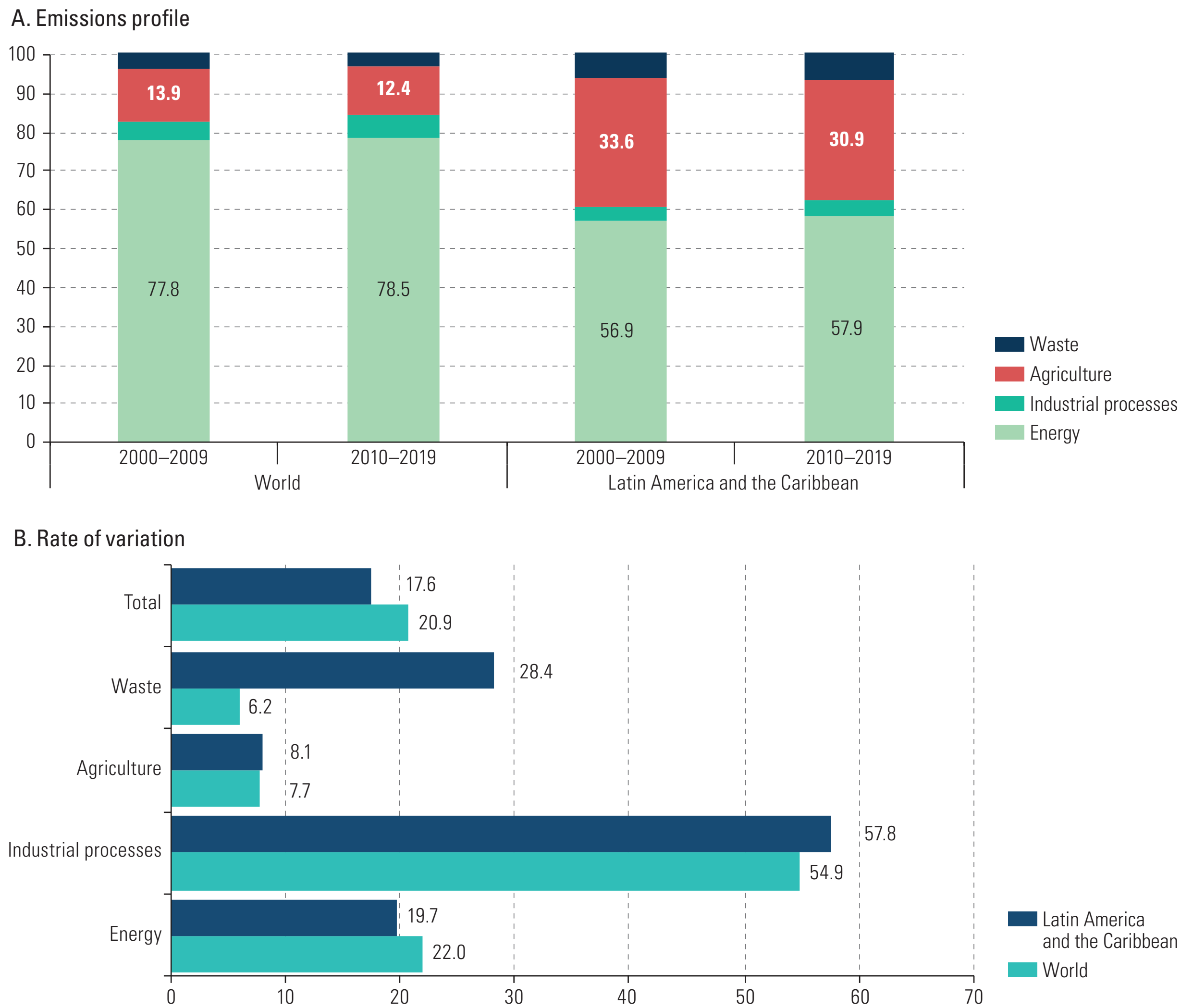
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

It is estimated that approximately half of the nitrogen contained in these fertilizers is not absorbed by the crops because of the lag between the point in time when the fertilizer is applied and when the crops need it. Much the same is true of seeded pastureland. The bacteria that are naturally present in the soil may convert the unabsorbed nitrogen into N_2O, or else the nitrogen seeps into and pollutes surface water bodies and aquifers. In extreme cases, this results in coastal dead zones. Natural pastures, on the other hand, are valuable nitrogen sinks.

3. Agriculture and greenhouse gas emissions

Worldwide, the agricultural sector's greenhouse gas (GHG) emissions represented 12.4% of the global total in the period 2010–2019, which was 1.5 percentage points lower than the average for the period 2000–2009 (see figure V.7). In Latin America and the Caribbean, the sector's share of the total fell by 2.7 percentage points between those two periods, slipping from 33.6% to 30.9%.

Figure V.7
Latin American and Caribbean region and world: profiles of greenhouse gas emissions and rates of variation in emissions, by sector of origin, 2000–2009 and 2010–2019
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en.

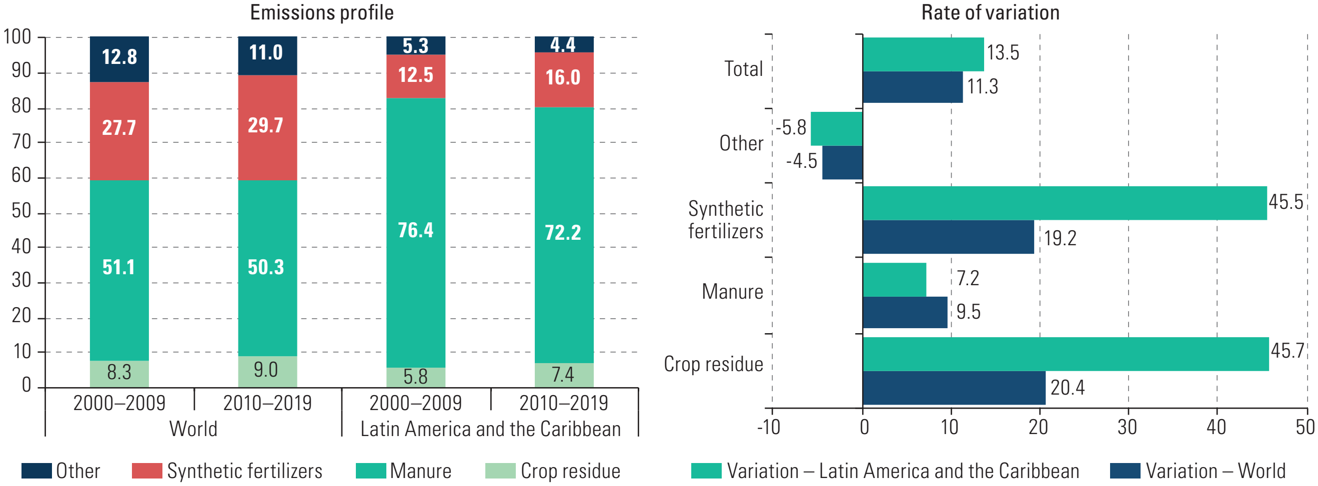
The Latin American and Caribbean region's agricultural sector accounts for 18% of GHG emissions from agriculture globally, which is well over twice as much as the region's total GHG emissions as a percentage of total GHG emissions worldwide (7%) (FAO, 2023). In absolute terms, over the past two decades, GHG emissions from the region's agricultural sector increased at a slightly faster rate than agricultural emissions at the global level did (8.1% and 7.7%, respectively). This rate was lower than the rates of increase registered in the other sectors of the economy, however (see figure V.7). In fact, agricultural emissions, both in the region and at the world level, increased more slowly than the emissions from industrial processes, energy and waste.

(a) Methane and nitrous oxide emissions

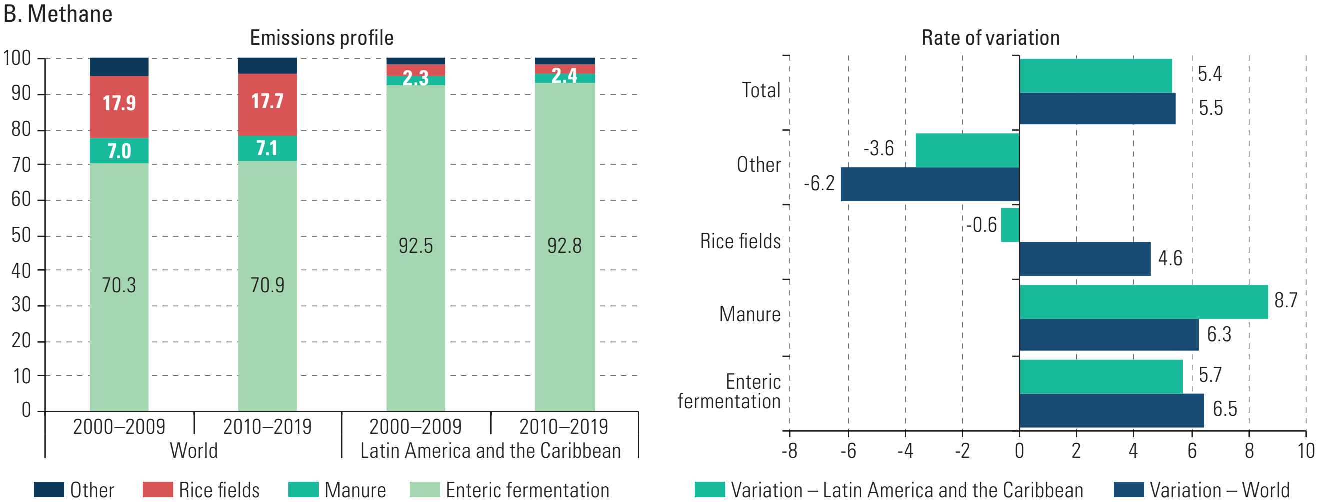
The two main greenhouse gases emitted by agricultural activities are methane (CH_4) and nitrous oxide (N_2O). Methane is produced by the decomposition of organic material, rice fields and ruminants' digestive processes and excreta. N_2O emissions are produced by the denitrification of manure in the soil, the burning of biomass and the use of nitrogen fertilizers. Figure V.8 depicts the N_2O and CH_4 emissions profiles and rates of variation.

Figure V.8
Latin American and Caribbean region and world: nitrous oxide and methane emissions profiles in the agricultural sector and rates of variation in emissions, by source process, 2000–2009 and 2010–2019
(Percentages)

A. Nitrous oxide



B. Methane



Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

In the 2010s, the main sources of N_2O emissions in Latin America and the Caribbean were manure (72% of the total compared to 50% at the world level) and synthetic fertilizers (16% compared to 30% globally). Crop residue accounted for a low percentage of these emissions (7%) but showed the sharpest increase of all the sources in absolute terms relative to the preceding decade (46% as compared to 20% globally). Total N_2O emissions from synthetic fertilizers also rose steeply (45% compared to 19% at the world level), whereas emissions from manure increased less than they did globally (7% as compared to 9%). Overall, the rate of increase in N_2O emissions in the region (13%) was similar to the global rate (11.3%).

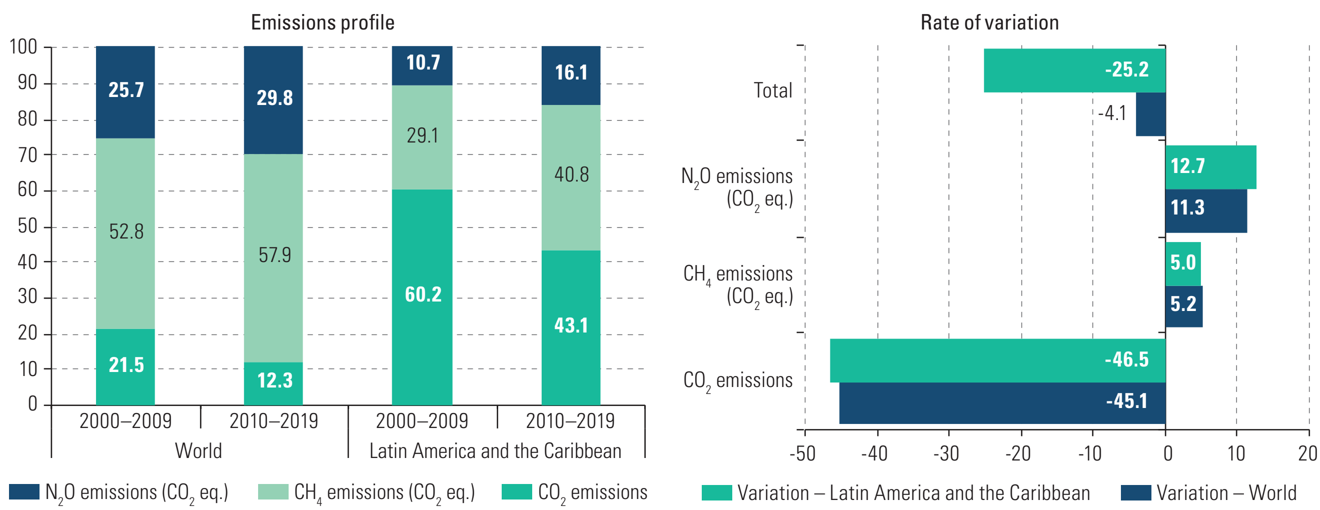
The three main sources of CH_4 emissions are enteric fermentation, manure and rice fields. The first two of these sources are associated with cattle herds and represented 95% of the region's CH_4 emissions in the 2010s (compared to 78% worldwide). Enteric fermentation was the source of the largest percentage of CH_4 emissions (93% of the region's total compared to 71% globally), whereas rice fields generated only 3% of the total (compared to 18% globally). In absolute terms, the highest growth rates in Latin America and the Caribbean were those of emissions from manure (9% compared to 6% globally) and from enteric fermentation (6% as compared to 7% at the world level). Emissions from rice fields declined slightly in the region (-1%) but rose by 5% at the world level.

(b) Emissions from agriculture, forestry and other land uses and emissions from land use, land use change and forestry

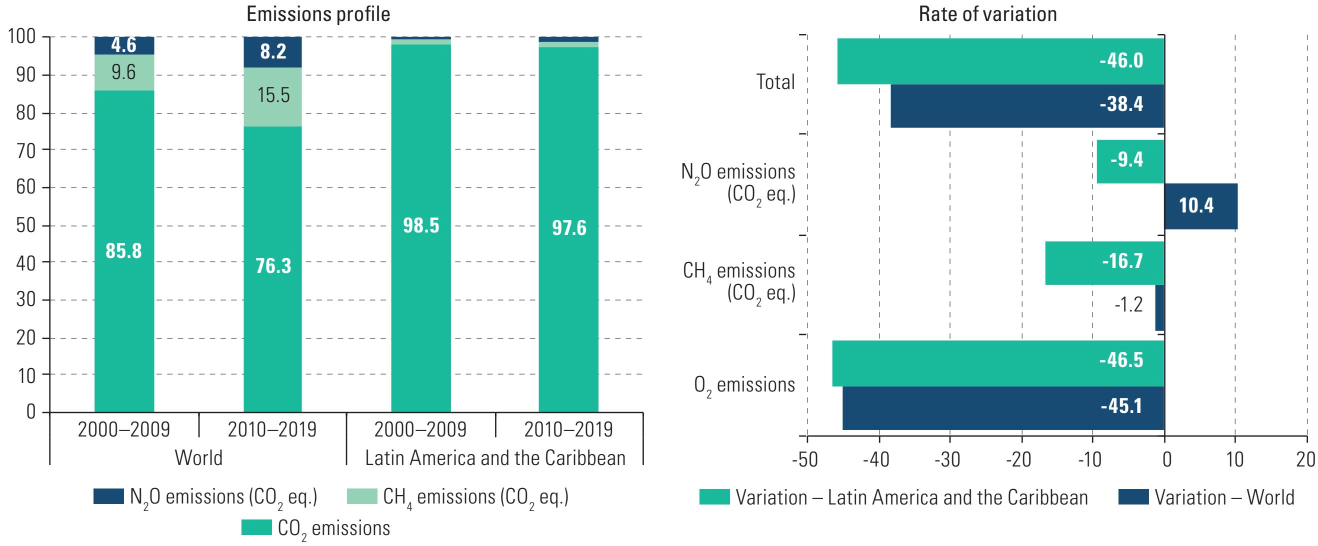
Figure V.9 shows the combined data for the agricultural sector's N_2O and CH_4 emissions plus the CO_2 emissions of agriculture, forestry and other land uses (AFOLU) and those of land use, land use change and forestry (LULUCF). The CO_2 emissions associated with AFOLU and with LULUCF are measured in two different ways. This is because the CO_2 emissions generated by land use change are measured in net terms, since both forests and soil are natural sinks. As a result, the resulting measurement may be negative, as it is possible for the amount of carbon that is captured to exceed the amount that is emitted.

Figure V.9
Latin America and Caribbean region and world: greenhouse gas emissions profiles and rates of variation for agriculture, forestry and other land uses and for land use, land use change and forestry, by type of greenhouse gas, 2000–2009 and 2010–2019
(Percentages)

A. Agriculture, forestry and other land uses (AFOLU)



B. Land use, land use change and forestry (LULUCF)



Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

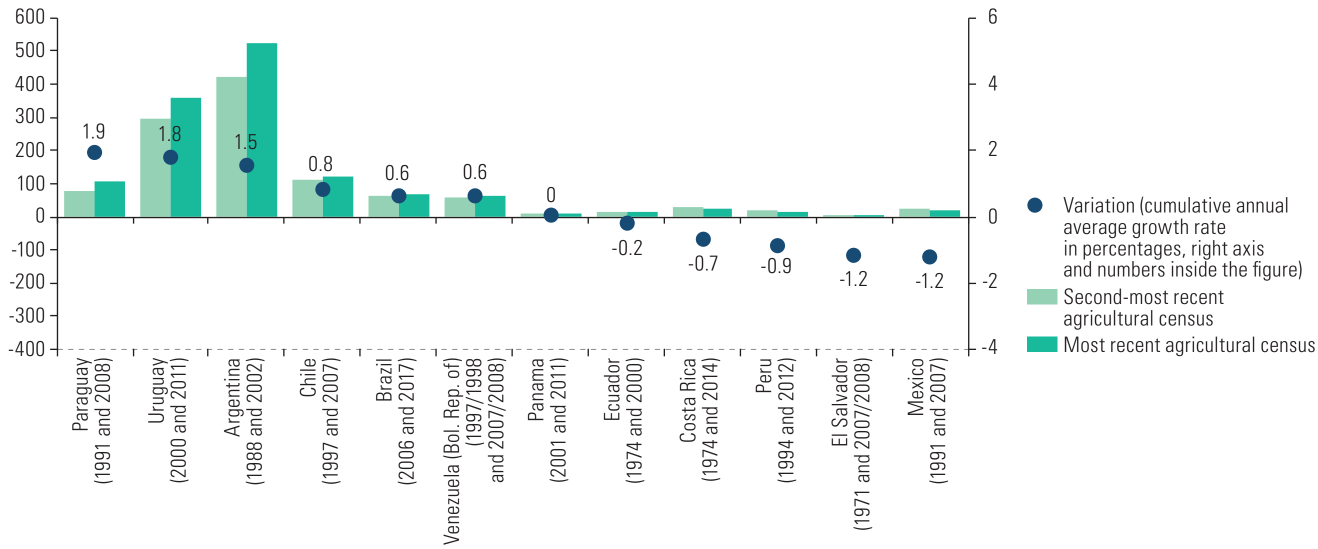
In the 2010s, the largest percentage of AFOLU emissions from Latin America and the Caribbean was in the form of CO_2 (43%), followed by CH_4 (41%) and N_2O (16%). On the global scale, the biggest component of these emissions was CH_4 (58%), followed by N_2O (30%) and CO_2 (12%). Over the past two decades, the percentages of CO_2 in the AFOLU emissions of Latin America and the Caribbean and of the world have declined, while the percentages of CH_4 and N_2O have increased. In absolute terms, AFOLU emissions diminished by 25% in Latin America and the Caribbean and by 4% worldwide, thanks to the reduction in CO_2 emissions, which came to 47% in Latin America and the Caribbean and to 45% worldwide. LULUCF emissions in Latin America and the Caribbean have been almost entirely composed of CO_2 (over 95%).

As can be seen from figure V.9, the overall decline in AFOLU and LULUCF emissions is almost entirely a result of the reduction in CO_2 emissions in Latin America and the Caribbean. In their turn, these trends have been driven primarily by the steep decrease in emissions from deforestation (FAO, 2020b).

4. Structural change and heterogeneity in agriculture

The region's agricultural production system consists of a mixture of small family farms and medium- and large-scale producers (see figure V.10). The agrarian structure is highly heterogeneous, and land is unequally distributed. At one end of the spectrum, there are large-scale production units using cutting-edge technology that have ample access to international markets. At the other end, there are around 16 million small farms, some of which are engaged in subsistence farming. Many of these farms use very little modern technology and have a difficult time gaining access to water (Namdar-Irani and others, 2020).

Figure V.10
Latin America (12 countries): average land area of agricultural production units and size variations
(Hectares and percentages)



Source: Prepared by the authors, on the basis of the two most recent censuses of agriculture of each country.
Note: The dates corresponding to the various figures are shown in brackets.

The agrarian structure exhibits diverging trends.[3] In some cases, the number of production units is on the rise, generally as part of an increasing degree of fragmentation as units are divided up into smaller holdings owing to land inheritance customs. In others, where the sector is experiencing strong growth in keeping with the expansion of the economy and the liberalization of investment, landholdings are becoming more concentrated and value chains are becoming more vertically integrated. In these cases, the number of production units, and especially of smallholdings, is decreasing.[4]

The scale of production is a decisive factor in determining the selection of markets, technologies and production models, and this will, in turn, determine how profitable agricultural production units will be. The fragmentation of these units also has environmental ramifications, because the subdivision of farmland puts greater pressure on the soil, since rotation cycles will be shorter, thereby depleting the organic materials contained in the soil and thus reducing its fertility more rapidly and setting the stage for soil erosion.

5. Major crops: area harvested, production and productivity

Table V.1 provides information on variations in the amount of land harvested and the yields of a sample of 15 major crops that have been classified as follows: traditional export products (i.e. bananas, cacao and coffee) and nontraditional export products (i.e. avocados, asparagus and pineapples); products that play an important role in ensuring food security, especially for low-income segments of the population (i.e. rice, beans, maize, potatoes, wheat and yuca); and flex crops, which are crops that can be

3 It is important to note that this information corresponds to different time periods. The last agricultural census round was carried out around 2010, but not in all countries; in many cases, the most recent agricultural census dates back to the 1990s and, in some cases, to the 1980s. The information available from other sources, such as household surveys and population censuses, is not a sufficient basis from which to draw reliable conclusions.

4 For a more detailed analysis, see Namdar-Irani and others (2020).

used to produce both food and biofuels (i.e. soybeans, oil palm and sugar cane).[5] The data are given by subregion, and the results for the first and second decades of this century are compared.

Table V.1
Latin America and the Caribbean: indicators for the area harvested and yields of 15 crops, by subregion, 2000–2009 and 2010–2019
(Percentages and tons/hectare)

	Rates of variation between 2000–2009 and 2010–2019 *(Percentages)*						Average yield in 2010–2019 *(Tons/hectare)*		
	Central America and Mexico		The Caribbean		South America				
	Land area	Yield	Land area	Yield	Land area	Yield	Central America and Mexico	The Caribbean	South America
Traditional export products									
Bananas	13.3	11.1	-0.3	12.5	15.7	9.2	41.90	14.58	19.73
Cacao	-1.8	-6.1	9.8	43.7	17.1	42.0	0.56	0.45	0.44
Coffee	0.5	-1.6	-26.2	-7.3	-9.4	33.6	0.64	0.34	1.17
Nontraditional export products									
Avocados	51.8	5.4	228.6	-2.5	68.9	3.0	10.09	13.84	9.07
Asparagus	53.2	87.7			35.4	13.7	7.94		10.43
Pineapples	57.7	13.4	25.3	89.3	18.7	9.4	52.67	26.42	32.45
Flex crops									
Sugar cane	19.2	3.4	-30.6	8.8	53.0	-1.1	80.39	41.25	74.05
Soybeans	146.7	-10.2			50.5	15.0	1.65		2.90
Oil palm	137.5	-5.3	3.1	-2.5	79.8	4.7	14.64	14.00	14.85
Food security									
Rice	-11.2	22.7	2.7	12.3	-13.6	30.1	4.39	3.97	5.39
Beans	-0.4	2.2	84.5	19.5	19.0	24.6	0.75	0.70	1.04
Maize	0.5	16.4	20.8	-0.8	28.2	40.2	3.16	1.31	5.26
Potatoes	4.3	6.3	-21.6	-8.8	5.2	17.6	26.55	20.26	17.57
Wheat	-2.5	8.9	0.0	0.0	-9.8	21.5	5.30	0.00	2.88
Yuca	36.3	15.8	36.2	1.3	-14.9	3.6	9.65	5.52	13.94

Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

The highest growth rates were recorded for flex crops (sugar cane, oil palm and soybeans) and for nontraditional exports (avocados, pineapples and asparagus). In Central America and Mexico, yuca is also a nontraditional export and has had a high growth rate. Most of the crops for which the harvested area has declined are crops considered to be important for ensuring food security (rice, beans, wheat and yuca in South America). Growth trends for traditional export crops were mixed. Crop yields for most of these products rose, with the steepest increases being seen in traditional export products and crops that play an important role in maintaining food security, especially in South America and in Central America and Mexico.

Table V.2 provides information on the role of different crops in total increases or decreases in the amount of land harvested. Soybeans made the biggest contribution to the increase in the area harvested (63%), followed by maize (19%) and sugar cane (13%). The largest increase in the area of land harvested in relative terms was for oil palm (94%), but that increase was from an initially small land area compared with the three crops that contributed the most to the total increase. The top crops for which, as a group, there was a reduction in the total amount of land that was harvested, were wheat (30%), rice (24%) and beans (23%).

5 These categories are not mutually exclusive.

Table V.2
Latin America and the Caribbean: amount and variation in the land area harvested for a sample of 15 crops, 2000–2009 and 2010–2019
(Thousands of hectares and percentages)

	Area harvested			Variation in absolute terms *(Thousands of hectares)*		Contribution to increase or reduction in total area harvested *(Percentages)*	
	2000–2009 *(Thousands of hectares)*	2010–2019 *(Thousands of hectares)*	Variation *(Percentages)*	Increase	Reduction	Increase	Reduction
Soybeans	35 906.6	54 136.0	50.8	18 229.4		63.4	
Maize	27 889.1	33 260.2	19.3	5 371.1		18.7	
Sugar cane	9 391.6	13 283.5	41.4	3 891.9		13.5	
Oil palm	638.3	1 237.1	93.8	598.7		2.1	
Cacao	1 475.6	1 696.8	15.0	221.2		0.8	
Bananas	1 190.7	1 352.8	13.6	162.1		0.6	
Avocados	212.7	365.6	71.8	152.8		0.5	
Pineapples	180.4	235.1	30.3	54.7		0.2	
Potatoes	990.4	1 036.5	4.7	46.1		0.2	
Asparagus	42.6	60.3	41.5	17.7		0.1	
Yuca	2 635.1	2 356.2	-10.6		-278.8		9.1
Coffee	5 717.3	5 294.5	-7.4		-422.8		13.8
Beans	7 067.9	6 363.7	-10.0		-704.2		23.0
Rice	6 029.0	5 278.7	-12.4		-750.3		24.5
Wheat	9 795.7	8 889.7	-9.2		-906.0		29.6
Total	**109 162.9**	**134 846.6**	**23.5**	**28 745.8**	**-3 062.2**	**100.0**	**100.0**

Source: Prepared by the authors, on the basis of Food and Agriculture Organization of the United Nations (FAO), FAOSTAT [online database] https://www.fao.org/faostat/en/#home.

The trends in 6 of the 15 products reflect the following types of factors:

(i) Changes in international demand. Soybeans are an example here, as the expansion of this crop was strongly influenced by demand from the People's Republic of China;

(ii) Emergence of new uses for agricultural products. Sugar cane (except in the Caribbean), oil palm and soybeans began to be used to produce biofuels;

(iii) Changes in public policy. The amount of land used for sugar cane decreased as a result of the elimination of tariff preferences, while the harvests of pineapple, asparagus and avocado crops increased thanks to the introduction of promotional policies;

(iv) Combinations of factors. In the case of soybeans, the land area that was harvested increased thanks to stronger demand from the People's Republic of China and to the fact that soybean began to be used to produce biofuel.

B. The bioeconomy: a new production paradigm for the development of agriculture and rural areas

1. The bioeconomy as a strategy for promoting sustainable development based on biological resources

In looking to the future of agriculture in Latin America and the Caribbean, some of the sector's fundamental aspects will have to be re-examined in a new light. On the one hand, in addition to long-standing structural challenges relating to diversification, structural change and value addition, new challenges are being posed by global environmental changes (e.g. climate change, biodiversity loss and ecosystem fragmentation and deterioration), changing consumer demand (e.g. demand for more healthful foods produced in a more sustainable way) and by the fallout from the COVID-19 pandemic. On the other hand, advances in the biological sciences and in digitalization are opening up new pathways for the sector's development.

There are a number of ways in which these challenges might be met: (i) as one way of addressing climate change, the carbon sinks associated with primary production activities, such as forests, soil and the seas, could be improved; (ii) the environmental problems caused by the use of synthetic nitrogen fertilizers and increased N_2O emissions point the way towards the development of biofertilizers and other biologically based inputs, which would also help to reduce the region's reliance on imports of synthetic fertilizers; (iii) since livestock are the foremost source of N_2O and CH_4 emissions, work should focus on improving the digestibility of grasses and fodder and introducing genetic modifications in order to improve cattle's methanogenesis; (iv) the negative externalities associated with the generation of a greater amount of agricultural waste (including manure) can be turned into an opportunity for producing bioenergy, biomaterials and other bioproducts that entail more value added; (v) changes in consumers' habits open up opportunities for diversifying production and developing products involving more value added, such as new proteins and more nutritional, better tasting food products that have a more appealing texture.

In order to improve existing carbon sinks, especially the soil, agricultural production systems will have to be re-engineered in order to change the way that agricultural activities are conducted and managed. The introduction of biologically based inputs and the utilization of agricultural waste will create opportunities for developing new products and value chains that can contribute to the diversification of production and value addition. Action taken in these directions can provide solutions for some of the sector's structural problems, such as its low productivity and lack of export diversification.

The bioeconomy is an alternative approach for taking on these challenges and capitalizing on the opportunities that they offer. Various studies and analyses (FAO, 2020b; MICITT, 2020; IACGB, 2018 and 2020; Gómez, Bogdanski and Dubois, 2019) describe the bioeconomy as the sum total of the production, utilization, conservation and regeneration of biological resources in combination with the related knowledge, science, technology and innovations that provide information, products, processes and services to all economic sectors that will lead towards the creation of a sustainable, inclusive economy.

The bioeconomy is also a technological paradigm in the sense proposed by Dosi (1982, p. 152), as it offers solutions for certain technological problems (such as the need to reduce GHG emissions and to adapt to climate change) that are based on principles deriving from the natural sciences (e.g. biological resources, principles, processes and systems) and selected technologies (e.g. biotechnology, nanotechnology, digital technologies, artificial intelligence and the convergence of all these technologies).

As noted by Perez (2010), the bioeconomy rests on the foundations of the technological revolution that has been unfolding in recent decades in the biological and life sciences, and it fulfils the two conditions set out by that author in order for it to qualify as such: first, the very close interconnection and interdependence of the relevant biological systems involved in the relevant technologies (biotechnologies) and markets (the biotech industry) and, second, their ability to completely transform the rest of the economy and even society into a post-fossil-fuels economy and society. Perez (2010) also points out that the bioeconomy is an emerging techno-economic paradigm capable of transforming other industries and activities (e.g. agriculture, food, clothing, energy, construction, chemistry and health), based on the technological revolution taking place in the biological and life sciences. As a technical production paradigm, the bioeconomy can expand upon the use of new technologies in these new industries and in others that have yet to take shape.

With its core materials and energy drawn from biological resources, the bioeconomy is an emerging techno-economic paradigm that serves as an alternative to its fossil-fuels-based counterpart. This latter paradigm was at its height during the second half of the twentieth century but is now in crisis —in the sense in which Kuhn (2021) uses the term to refer to crises that trigger scientific revolutions— as more and more scientific evidence surfaces about how fossil fuels have intensified climate change in recent decades (see, for example, IPCC, 2023). The technology of agrochemicals can thus be analysed as a reverse salient (Callon, 1987; Hughes, 1987)[6] in relation to these critical problems, which alter technological selection processes (Constant, 1980) and pave the way for innovation by withdrawal and technological substitution (Stern, Ayres and Shapanka, 1975). Perez (2010, p. 189) shows how, as new sectors expand and become long-lasting engines of growth, the resulting techno-economic paradigm drives a sweeping reorganization and widespread increase in productivity in pre-existing industries. The consolidation of the bioeconomy as a techno-economic paradigm hinges on its success in bringing about that widespread gain in productivity.

The techno-economic paradigm of the bioeconomy has three distinctive features. The first is that biomanufacturing —understood as the use of biological systems to develop products, tools and processes at commercial scale— serves as its industrial production model (Executive Office of the President of the United States, 2022). The second is biomimicry (Benyus, 1997), which entails emulating and replicating biological systems, processes and principles in, for example, design processes in areas including manufacturing, waste management, urban development and architecture (Vincent and others, 2006). The third is the application of biotechnologies (understood in a broad sense to cover everything from fermentation to omics technologies and synthetic biology) or their use in combination with other convergent technologies, such as nanotechnology (nanobiotechnology) and digital technologies such as bioinformatics.

The bioeconomy is emerging as the "solution for the puzzle" (Kuhn, 2021) at a time when concern about climate change and the sustainability of agriculture is causing a crisis in the technological paradigm (Dosi, 1982) and the techno-economic (Perez, 2010) paradigm, both of which are based on fossil fuels. The bioeconomy can make a positive contribution to both adaptation and mitigation and can help to amplify the synergies between the two. For example, through the development of new biologically based inputs and the generation of bioenergy, the bioeconomy can help to reduce GHG emissions. In addition, modern biotechnologies can be used to develop plant varieties that are more resistant to water, heat and salinity stress and that thus serve to enhance the sector's resilience. In addition to the production of food, fibres and fodder, the bioeconomy can also use crops and other biological entities, such as biofactories, to produce inputs and products more efficiently that are currently manufactured using traditional chemical processes (e.g. biomolecules).

In order to further the development of agriculture and rural areas within the framework of the bioeconomy, an approach is being proposed that rests on three pillars: (i) agroecology as the primary production system; (ii) digitalization as a fundamental means of monitoring the relevant processes; and (iii) new technologies (such as biotechnology, nanotechnology and cognotechnology) as a means of boosting productivity and managing water resources, soil and biodiversity more sustainably. This approach

[6] These authors describe reverse salients as components of a system that falls out of sync with others because it is unable to successfully address critical problems.

focuses on three main objectives: (i) a more sustainable, resilient production system (ii) diversification and value addition; and (iii) social inclusion. The main challenge is to make this model workable at all levels of the agricultural sector, from the smallest holdings to large-scale producers.

2. The agroecological transition as a production model for the development of the agricultural bioeconomy

(a) Returning to basic biological principles in primary agricultural production

The aim of agroecology —a combination of agronomy and ecology— is to create diversified agroecosystems that mimic natural systems as closely as possible in order to make production processes more sustainable (FAO, 2018a). The objective of transitioning to agroecology on the basis of conventional agricultural models is to reinstate adherence to fundamental agroecological principles. This change is being driven by an awareness of the importance of conservation and regeneration and is being accomplished by combining traditional practices and techniques with technological innovations that can be used to help build more efficient production models capable of providing reliable, safe products that have market value and that are healthful for farmers and the environment.

Climate change makes it imperative for all production segments and all production chains to make headway in this direction. This is why FAO (2018b) has called for successful agroecological production and consumption experiences to be scaled up to the point where they can encompass the entire food system.

Agroecologically based agricultural production systems are of key importance for the development of a sustainable bioeconomy. From a conceptual standpoint, the priority is to preserve the region's surviving natural systems that play an important role in maintaining global environmental balances: the Amazon Basin is a priority system, as it covers an area measuring 600 million acres (30% of the total area of the region), but there are also other major agricultural systems that are still relatively untouched, such as the Cerrado, which takes in 11% of the total area of the region, and the Gran Chaco and Patagonia, each of which accounts for 3% of its total area. New production models will also be needed in systems with high population densities, such as coastal croplands and the maize and bean production areas of Mexico and Central America, or systems which are being intensively farmed or grazed, such as the pampas of Argentina and Uruguay (Gulliver and Gibbon, 2001). The underlying premise is that each system has to make its own agroecological transition. Clearly, this will entail going beyond the bounds of family farming and Indigenous agriculture, where this model is quite advanced, to reach major agricultural holdings, especially the extensive, large-scale production units operating in South America.

(b) Bioeconomy, agroecology and climate action

The bioeconomy and agroecology offer ways to avoid, reduce or capture GHG emissions in the agricultural sector. Agroecological practices associated with improved land and soil management can help to cut the CO_2 and N_2O emissions of crop-farming activities, and improved practices in the areas of stock feed and pasturage can help to lower CH_4 emissions. The introduction of bioinputs can lessen the need to use nitrogen fertilizers, thereby reducing N_2O emissions; and the utilization of wastes (e.g. in biorefineries) can substantially lower the N_2O and CH_4 emissions associated with the disposal and decomposition of waste in rural areas.

Another means of reducing the agricultural sector's N_2O emissions is precision agriculture. This alternative is linked to the bioeconomy and the convergence of biotechnology and digital technologies that make it possible to determine the specific nutrient needs of each crop on the basis of soil conditions and to differentiate and vary the amounts of the corresponding inputs. The Goldman Sachs Group (2016) estimates that farmers who do not use precision technology use 40% more fertilizer on their fields than they should and that this overuse translates into 10% lower yields than those achieved by farmers who do use these technologies.

Another approach that is more closely linked to agroecology and results in improved nitrogen management is based on an awareness of the capacity of the soil to regenerate and to recover the required levels of nutrients. This agroecological approach, which is known as regenerative agriculture, focuses on working with nature to restore the system's overall health. A variety of techniques are associated with this approach, including the use of bioinputs such as compost, crop and herd rotation, and agroforestry.

3. The bioeconomy and new agricultural technologies for the development of the agricultural sector

(a) Process and service delivery management

The use of new technologies in agriculture opens up an entire range of opportunities for improving production processes and moving the agroecological transition forward. Digital technologies, information and communications technology (ICT) and the whole range of biotechnologies should be at the forefront, together with the introduction of nature-based solutions and the promotion of agroecological practices. This constitutes a paradigm shift towards reconciling the objectives of productivity and sustainability and bringing producers and consumers closer together. In terms of access to these technologies, the aim should be to ensure that no farmer is left behind.

Digital technology applications have at least five major effects: (i) they reduce the use of inputs; (ii) they are conducive to innovation and increased productivity; (iii) they facilitate cooperation among agricultural producers; (iv) they open the way for a direct connection between producers and consumers; and (v) they increase market transparency. Taking advantage of these opportunities in an inclusive manner will, however, require major adjustments in policies and service delivery processes.

Digital technologies are already proving to be a useful tool for speeding up this transition. Three of the various ways in which they are being put to use are as follows: (i) mobile phones are being used to obtain information on the weather, make new contacts among producers and consumers, create communities around shared interests (e.g. *Yo Joven y Rural* in Chile) and coordinate productions chains (e.g. Think Tank Cacao in Ecuador); (ii) digital technologies are being used to keep track of yields; and (iii) digital technologies, such as block chains and artificial intelligence (AI), are being used for such purposes as data standardization and the processing of transactions.

Industry 4.0 technologies have not yet come into widespread use in the region's agrifood sector. There is not a great deal of information to be had on the availability of this type of technology, nor are there any reliable cost-benefit analyses of their use; in addition, the relevant producers' and technical personnel's digital skills are very limited, and the predominance of small farms makes gaining access to digital technologies more problematic. All of these factors can amplify the power imbalances existing in agro-industrial chains and markets to the detriment of family farms and underprivileged areas. Thus, there is a very real risk that digital technologies will widen existing technological and social gaps. This type of rapid technological change can have a positive impact on the rural economy and society, however, if it is managed correctly. Agriculture 4.0 can and should be one of the engines driving the agroecological transition.

Biotechnologies can also play a part in such areas as boosting the resilience of agricultural production by, for example, helping to make crops more resistant to drought and salinity stress; improving soil health and restoring depleted soil with the aid of technologies targeting soil microbiomes; reducing producers' reliance on fossil-based inputs through the use of bioinoculants, biofertilizers and biopesticides; and enhancing food products' nutritional profiles through, for example, biofortification.

(b) Diversification of production and value addition

Based on the technological sophistication of the various production processes and the nature of the products themselves, three developmental levels of the bioeconomy can be distinguished, with the extent of value addition increasing from one level to the next (Rodríguez, Mondaini and Hitschfeld, 2017): (i) the primary-sector bioeconomy (e.g. agriculture, fisheries and forestry); (ii) the raw material processing bioeconomy (e.g. the food, wood, leather and natural textiles industries, as well as bioenergy); and (iii) the high-value-added bioeconomy (e.g. biochemicals, bioplastics, biopharmaceuticals and biocosmetics, as well as industrial enzymes).

The major challenge for the region's bioeconomy is to progress towards a greater degree of diversification and value addition in its production processes, and the use of biological technologies is one of the pathways that can lead in that direction. The manifold applications for such technologies in agriculture include the development of improved crops and foods; the development of further non-food uses for crops (e.g. biodegradable materials, vegetable oils and biofuels); the utilization of agricultural, forestry, fishery and agro-industrial waste and residues (e.g. to create new products that can be used as inputs in other sectors of the economy); the production of biopesticides, biofertilizers and other bioinputs); and bioremediation as an environmental management tool (e.g. to reclaim degraded or polluted soil and to treat wastewater).

4. United Nations Food Systems Summit, the bioeconomy and nature-based solutions

Given the potential for food systems to promote progress towards the fulfilment of the 2030 Agenda for Sustainable Development and the achievement of a majority of the Sustainable Development Goals, in October 2019 the Secretary-General of the United Nations, António Guterres, convened the 2021 Food Systems Summit as part of the decade of action for attaining the Goals by 2030.

Participants at the Summit, which was held on 23 and 24 September 2021, underscored the importance of calling for a transformation of food systems in order to make them more sustainable, inclusive and resilient, and capable of delivering safe, nutritional foods. The Summit made it clear that this transformation is essential to ensure that food systems will make a greater contribution to the economy, people's livelihoods, food and nutrition security, health, the reduction of poverty and of ethnic, gender and territorial inequalities, the conservation and sustainable use of biodiversity, and climate action.

Food systems can also contribute to the recovery from the crisis caused by the COVID-19 pandemic. In his call to action, the Secretary-General indicated that food systems can play an essential role in driving the global recovery in three fundamental areas: (i) working for people (nutrition for health and well-being); (ii) working for the planet (producing in harmony with nature); and (iii) working for prosperity (inclusive, transformative and equitable recovery for the 2030 Agenda). In speaking about the planet, the Secretary-General emphasized that it is possible to feed a growing world population while still protecting the environment by ensuring that sustainable production methods and consumption patterns are in place and by employing nature-based solutions.

The preparatory work carried out in the run-up to the United Nations Food Systems Summit 2021 included national, independent and global dialogues, online consultations and meetings focusing on the presentation of innovative approaches. This preparatory process resulted in the identification of five action areas to help inform the transitions needed to realize the vision of the 2030 Agenda (United Nations, 2021). One of those areas is "boosting nature-based solutions", and priority is placed in that connection on Sustainable Development Goals 2, 6, 7, 8, 9, 13, 14, 15 and 17.[7] This action area revolves around three major objectives:

(i) Optimizing the use of environmental resources in food production, processing and distribution in order to reduce biodiversity loss, pollution, water use, soil degradation and GHG emissions;

(ii) Attaining a deeper understanding of the limitations and opportunities encountered by farmers, fishers and small-scale ventures all along the food value chain;

(iii) Supporting a form of governance for food systems that will permit the realignment of incentives for reducing food loss and wastage and other negative environmental impacts while at the same time engendering positive externalities.

Proposals of innovative solutions were grouped into clusters. A variety of mechanisms were also proposed, such as initiatives, partnerships and coalitions, to help countries and regions promote the vision of the Summit around the creation of more inclusive, resilient, equitable and sustainable food systems by 2030. The clusters and coalitions relating to the action area of nature-based production solutions are listed in table V.3.

Table V.3
United Nations Food Systems Summit 2021: clusters and initiatives, partnerships and coalitions relating to the action area on nature-based production solutions

Solution clusters	Initiatives, partnerships and coalitions
Deforestation-free and conversion-free food supply chains (cluster 3.1.1) Reuse of public aid for food and agriculture (cluster 3.1.2) Land-freshwater nexus (cluster 3.1.3) Transformation through innovation for nature-positive production (cluster 3.2.1) Transformation through agroecology and regenerative agriculture (cluster 3.2.3) Agrobiodiversity (cluster 3.2.4) Aquatic and marine foods (cluster 3.2.5) Indigenous Peoples' food production systems (cluster 3.2.6), Grasslands and savannahs (cluster 3.3.1) Alignment of data, stakeholders and evidence for nature-positive production (cluster 3.3.2) Coalition of Action for Soil Health (CA4SH) (Global Soil Hub) (cluster 3.3.3)	Transformation of food systems through agroecology Coalition for aquatic and marine foods Resizing the livestock industry Sustainable livestock around the world Restoration of grasslands, shrublands and savannahs through sustainable extensive cattle-based food systems Global action agenda for promoting nature-positive innovation Coalition of Action for Soil Health (CA4SH) Redirecting public support towards food systems and agriculture Deforestation free supply chains of agricultural commodities Improved, data-based decision-making to ensure that production is nature-positive Land and freshwater Agrobiodiversity

Source: United Nations, "Strengthening capacity in food systems" [online] https://foodsystems.community/game-changing-propositions-solution-clusters/.

7 The other four areas are: nourishing all people; advancing equitable livelihoods, decent work and empowered communities; building resilience to vulnerabilities, shocks and stresses; and accelerating the means of implementation.

The Scientific Group of the Summit (von Braun and others, 2021) made seven recommendations concerning science-driven innovations for integrated implementation as a means of transforming the world's food systems. In the area of the bioeconomy, emphasis was placed on bioscience innovations for supporting people's health, system productivity and ecological well-being. With regard to nature-based solutions, the focus was on maintaining and, where necessary, regenerating productive soil, land and water resources and on protecting the diversity of the agricultural genetic base and biodiversity.

Among the opportunities for innovation offered by the biosciences, the Scientific Group underlined genetic engineering, genome editing, alternative sources of proteins (including more plant-based and insect-derived protein) and essential micronutrients, cell factories, microbiome and soil and plant health technologies, plant nutrition technologies, and animal production and health technologies. In order to ensure that poor communities are not left behind, the Scientific Group stressed that governments "need to invest in the creation of capacities and expertise to develop and utilize biosciences and digital technologies and receive support for that from development partners". The Group also spoke of the need to ensure that Indigenous Peoples and the local population in general received the benefits of the innovations resulting from their interactions and the information they shared with scientists (von Braun and others, 2021, pp. 15 and 16).

With regard to innovations offering nature-based solutions, the Scientific Group underlined the "need to advance knowledge concerning plant genetic diversity and microbial diversity, taking local climate variability into account" and the importance of harnessing soil microbes to improve the structure of depleted soil, carbon capture and yields. It also said that the use of handheld digital devices for measuring soil carbon in fields and for taking remote sensing measurements can open up opportunities in the areas of climate policy and productive plant nutrient management. Lastly, the Group spoke of the importance of innovations in agroforestry for large-scale productive land use in combination with ecological and climate-positive ecosystems services (von Braun and others, 2021, pp. 16 and 17).

C. Institutions, policies and governance

1. Policies and institutions

In 2011, ECLAC carried out a study on agricultural policies which attested to the presence of a highly diverse range of policy institutions and approaches to policy interventions in the region (Sotomayor, Rodríguez and Rodrigues, 2011). The study indicated that most of the countries in the region have basic policy instruments focusing on agronomic and zootechnic research, health, and domestic and external trade. Some countries also have a government-funded promotion system linked to their policies on innovation, investment and, to a greater or lesser degree, environmental sustainability as part of their rural development programmes for small-scale farmers. Very few countries have any sort of insurance system to help to protect farmers from weather-related losses and price volatility, leaving most producers at the mercy of frequent external shocks.

The region's basic institutional fabric is extremely valuable and should be further strengthened. At the national level, sectoral ministries (e.g. agriculture, the environment and economic affairs) play a key role in regulating the agrifood system. They work alongside specialized bodies in such areas as research, health, quality control, irrigation and other technical fields, as well as with banks and other credit institutions that play an important role in providing the necessary financing. Employers' associations, quasi-official agencies, cooperatives and producers' organizations of all sizes also play an active role, as do Indigenous communities, non-governmental organizations, foundations and other rural organizations.

Nevertheless, many of these policy instruments have been weakened in recent years by the fiscal constraints experienced by all the countries of the region in the wake of the commodity supercycle. It is foreseeable that the region's experience with the COVID-19 pandemic may heighten this trend and alter approaches to public policy.

2. Resilience in coping with global shocks

The pandemic will continue to have a strong impact on the economy going forward, and the region will have to muster a great deal of creativity and commitment in order to recover its growth trajectory while at the same time overcoming the social and environmental challenges that it faces. The impact on the region's societies and the way in which individuals behave will not be inconsequential either, and this may have significant medium- and long-term repercussions for how food and other agricultural goods are produced and consumed. Given this situation, action will need to be taken in six main areas to promote the development of agriculture and rural areas during this new stage in the region's history, as set out below.

(i) The pandemic has clearly demonstrated that the State plays an indispensable role in dealing with this type of systemic crisis and that there will inevitably have to be a readjustment in many areas. The quality of public policies is an important factor in contending with a crisis and coming through it successfully.

(ii) When fiscal resources are scarce and greater transparency is called for, it is important to give local communities, businesses and other civil society actors an active role to play in devising and jointly managing public policies and to rely on social participation as a crucial factor in achieving greater legitimacy, efficiency and impact.

(iii) The crisis has clearly demonstrated the need to make supply chains less vulnerable. To that end, improvements will have to be made in logistics, the integration of suppliers and traceability (including to deal with the risk of zoonosis), and storage capacity for local output will have to be increased, while offshoring —the dominant model until the crisis erupted— will have to be reduced in ways that will combine efficiency with resilience. Attaining this objective will entail striking new balances in terms of the diversification of production, supplier redundancy, value addition and intersectoral linkages in line with the bioeconomic approach.

(iv) The approaches to targeting public programmes will have to be rethought, and a new balance will have to be struck between public goods (health and information, among many others) and private (appropriable) goods. Small businesses are the weakest links in value chains and, in order to strengthen them, the focus will need to be on the poorest segments of family farms, small and medium-sized enterprises and the inhabitants of rural areas. These segments have traditionally been given short shrift in public budgets, but greater attention will need to be devoted to them if poverty is actually to be reduced and if the challenges of the 2030 Agenda are to be met with success. Accordingly, investment in the production capacity of smallholders and rural areas that meets some minimum threshold is indispensable.

(v) A new generation of policies is required that will expand the coverage of public programmes, cut their cost, boost their quality and enhance their impact. In order to accomplish this, the leadership capabilities of participants in rural chains and territories will have to be used to full advantage, as will all available cognitive and material resources, with special emphasis on nature-based solutions (e.g. agroecology and the integration of existing conventions on climate change, biodiversity and efforts to combat desertification), short marketing circuits and associative models. All this must be melded with new digital and biological technologies, along with other types of scientific knowledge from universities, businesses and public agencies, in order to add value and help to shape the sustainable bioeconomy. There is a vast potential for cross-fertilization across all these types of technologies (Neugebauer, 2020).

(vi) Systemic crises result in huge business losses —losses too great to cope with through individual action. Moreover, businesses' reputations with consumers are at stake during these types of emergencies. All this sets the stage for the development of a new form of corporate social responsibility that goes beyond philanthropy and efforts to build shared value (Porter and Kramer, 2006) and that involves greater transparency on the part of business enterprises about their labour and environmental practices. Firms should commit to implementing collective strategies for reducing systemic risks in coordination with local communities. Collaborative networks and new types of relationships between local actors and large companies in the agrifood sector are needed.

The impact that the COVID-19 crisis and the conflict between the Russian Federation and Ukraine have had and are having on the agricultural sector and on supply chains heightens concerns about food shortages and rising food prices that may exacerbate existing food insecurity. The pandemic brought to light some of the weaknesses of the global agrifood system and revealed just how closely linked human health, animal health and the health of the environment are. For decades, the strategies of leading agrifood enterprises have prioritized the efficiency of production systems that are contributing to climate change and biodiversity loss. At the same time, policies concerning the sector have been designed in isolation, with little coordination among institutions concerned with agriculture, nutrition and food, the environment, water resources, health, weather and climate, infrastructure, telecommunications and finance, among others. The pandemic has clearly shown just how interdependent these seemingly unconnected areas are. To deal with these problems, all these institutions need to work within the framework of public-private partnerships and inter-agency platforms that will enhance the efficiency of the collective efforts needed to bring about an economic recovery. Although this approach is already being applied in all the countries of the region, it is taking on critical importance under the current circumstances, leading various multilateral institutions to study it in greater depth recently (ECLAC/FAO/WFP, 2022).

The methods used by farmers to produce food have an impact on human health and on the health of the planet's ecosystems. In that regard, a proper approach can help to combat climate change, maintain biodiversity and curb the spread of disease. Agricultural producers should therefore receive support in the areas of production and environmental protection, and their sources of income should become more diversified. A transition towards locally based, socially just and environmentally resilient food systems is urgently needed. These factors are part of an approach centred on building a sustainable bioeconomy that can generate added wealth and greater well-being for all, in all sectors and in all areas, both urban and rural.

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CHAPTER VI

The contribution of hydrocarbons to the economic and energy transition

Introduction

A. Situation with respect to reserves, production and consumption of hydrocarbons

B. Economic impacts of hydrocarbons: investment, international trade and tax revenues

C. Towards a new governance of fossil energies?

D. Conclusions

Bibliography

Introduction[1]

This chapter covers the years between 2000 and 2021, a period that was marked by world events that had significant repercussions on global markets, especially for hydrocarbons. These events included the commodity boom, the global financial crisis of 2008–2009, the coronavirus disease (COVID-19) pandemic, and the war between the Russian Federation and Ukraine. Global energy supply and demand are at the mercy of geopolitics, as they are based on raw materials such as coal, natural gas and oil, whose production is fairly concentrated in a small number of countries, owing to the existence of the Organization of Petroleum Exporting Countries (OPEC) cartel. This fuels fossil fuel price cycles and their resulting volatility, with differentiated economic and social effects across world regions, depending on whether economies are net exporters or importers of these energy resources.

Two factors have added to the challenge posed by dependence on fossil fuel prices and international trade —whether countries are suppliers or consumers, or both. First are the commitments assumed in relation to sustainable development agendas and efforts to combat against climate change, for which the energy transition towards low-carbon emissions systems is fundamental. Second, the effects of the aforementioned cascading crises have pushed countries to redouble their efforts to achieve greater energy security and sovereignty. The last two crises in succession —the COVID-19 pandemic and the war in Ukraine— led to a steep rise in fossil fuel prices after their collapse in the initial stages of the pandemic, amid supply and demand imbalances resulting, first, from containment measures, followed by a rapid recovery of economic activity. Added to this were sanctions against the Russian Federation and its responses relating to gas supply to Europe. However, energy geopolitics have played a key role in the trends in prices, fuel scarcity in the markets and the global energy crisis. For example, the Organization of the Petroleum Exporting Countries Plus (OPEC+) —composed of the original members of OPEC plus 10 other producing countries, including the Russian Federation— controls the oil production of those countries via quotas that have not been altered at the rate that post-pandemic growth would have suggested. Likewise, steps taken by the member countries of the International Energy Agency (IEA) have provided some relief to the markets, but have been insufficient.

The first section of this chapter presents the situation of the oil and natural gas industries in the region's fossil-resource-rich countries, in the current highly complex context marked by great uncertainty about the future and, therefore, fraught with challenges. The second section describes trends in international fossil fuel prices, recent shifts in energy investments around the world and in the region resulting from these prices, and the role of State oil companies in the region in investment in fossil fuel supply. It also explains how the performance of the hydrocarbons industry in the region has led to a fuel trade deficit, grouping the economies by net exporters or net importers. The third section offers guidelines for an energy policy aimed at transforming the fossil energy sector and making it more sustainable (by sequestering and managing emissions). Among other things, this would mean finding low-carbon energy sources to achieve a just transition and reduce dependence on fossil fuels, increase energy security and sovereignty and improve access to clean, renewable sources and their coverage. The final section sets forth conclusions summing up the main messages and proposing a number of policy guidelines.

[1] Most of the data and information included in this chapter refer to the period 2000–2021. Where available, later data are also included, up to 31 March 2023. Unless otherwise indicated, the source for the data presented is BP (2022) and its database.

A. Situation with respect to reserves, production and consumption of hydrocarbons

1. Fossil energy supply in Latin America[2]

In keeping with the global trend, the composition of the total energy supply in Latin America and the Caribbean has changed significantly, with a considerable decline in fossil sources and an increase in renewables (see table VI.1). The fossil energy supply has fallen by 19 percentage points in the last 20 years, to less than 60% of the total supply. Compared to the global average, the region has a larger share of natural gas in electricity generation (the share of coal has remained stable and the share of oil has fallen), as well as faster penetration of renewable energies (hydropower of all scales and types and several renewable energies).[3]

Table VI.1
Latin America and the Caribbean (22 countries): share of fossil energies in total energy supply, 1998–2020
(Percentages)

Primary source	1998	2000	2005	2008	2010	2015	2018	2019	2020
Oil	49.4	47.7	44.8	42.8	39.8	33.8	27.7	28.5	27.5
Natural gas	24.2	24.7	27.4	25.7	26.0	28.4	29.5	28.1	27.1
Coal	4.5	5.0	4.3	4.8	4.8	5.4	5.3	5.2	4.5
Total fossil energies	78.1	77.4	76.5	73.2	70.6	67.7	62.6	61.7	59.1

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Latin American Energy Organization (OLADE), "Energy balance matrix", Energy Information System of Latin America and the Caribbean (sieLAC) [online] https://sielac.olade.org/WebForms/Reportes/ReporteBalanceEnergetico.aspx?or=600&ss=2&v=1.
Note: Secondary sources are not included in total fossil energy sources.

2. Oil

In the past 20 years, the share of global oil reserves in Latin America and the Caribbean grew significantly, from 9.3% of world reserves in 2000 to 19.0% in 2020, equivalent to a reserves-to-production ratio of 113 years (see table VI.2).[4] This is explained mainly by the increase in proven reserves in the Bolivarian Republic of Venezuela, in the Orinoco River belt (extra-heavy crude oil, which is usually classified as "non-conventional" and is certified based on information from OPEC and official announcements) and, to a lesser extent, the pre-salt reserves in Brazil (heavy to moderate crude oil, in very deep waters, below a thick layer of salt).[5] Reserves of the Bolivarian Republic of Venezuela quadrupled in 20 years, from 76.8 billion barrels in 2000 to 303.8 billion in 2020, representing 17.5% of global reserves and a reserves-to-production ratio of over 1,000 years.[6] Without the Venezuelan reserves, the region's reserves-to-production ratio would be just 9.8 years.[7]

2 This document does not describe the situation of coal in Latin America and the Caribbean because this energy source accounts for only a small share of the region's total energy supply.

3 The share of renewable energies in the total primary energy supply in 2017 was 30% in Latin America and the Caribbean and 15% in Europe. These regions rank first and second in the world in this regard. See more information in IRENA (2020).

4 Based on the average oil production in the region for the period 2019–2021, estimated at 8 million barrels per day (mb/d) (but 7.8 mb/d in 2021) (BP, 2022).

5 OPEC has 13 members: Angola, Algeria, Bolivarian Republic of Venezuela, Congo, Gabon, Equatorial Guinea, Iraq, Islamic Republic of Iran, Kuwait, Libya, Nigeria, Saudi Arabia and United Arab Emirates.

6 Based on the country's average oil production in the period 2019–2021, which was estimated at 0.8 mb/d (but 0.6 mb/d in 2020) and was 63.9% lower than the average for 2016–2018.

7 Not including the country's average oil production in the period 2019–2021 (see note 6). The region's average oil production in that period without the Bolivarian Republic of Venezuela was estimated at 7.2 mb/d.

This is an average, as the ratio in some countries is less than 10 years. This could be interpreted as a sign of a possible supply problem in the short or medium term in the absence of other exploration efforts.

Thus far great difficulties have arisen with regard to exploiting the reserves of the Bolivarian Republic of Venezuela, so these have not contributed to growing the country's production. In addition, the generally low production of its traditional basins goes some way to explaining the stagnation and decline in the total crude oil production of Latin America and the Caribbean. The region's importance in global production has thus trended contrary to its reserves. In the past 20 years, regional production went from 10.1 million barrels per day (mb/d) in 2000, representing 13.6% of world production, to a peak of 11.2 mb /d in 2006 (13.5% of production), then fell sharply to 7.8 mb/d in 2021, a drop of 22.8% since 2000 and a share of only 8.7% in world production.

Global supply has grown almost continuously since 2000. It rose from 74.5 mb/d in 2000 to peak at 95.0 mb/d in 2019, and then fell to 90.0 mb/d in 2021, representing an overall increase of 20.6% in the last 21 years. OPEC global production rose only 5.3%, from 30.1 mb/d to 31.7 mb/d, in the period 2000–2021, having fallen by 5.7 mb/d compared to its 2016 peak. The growth in global oil supply between 2000 and 2021 is thus accounted for by North America (Canada and the United States), with production that doubled from 10.4 mb/d to 22.0 mb/d, and the group of countries that make up OPEC+.[8] After 2017, this grouping took steps to adjust supply and its production rose from 13.1 mb/d to 17.3 mb/d. The share corresponding to OPEC in the production fall in 2020 —due to the effects of the COVID-19 pandemic and the measures taken to combat it— was considerable, at -4.1 mb/d. This reflected mainly the declines in Libya (-0.8 mb/d), Saudi Arabia (-0.8 mb/d), Iraq (-0.7 mb/d) and the Bolivarian Republic of Venezuela (-0.4 mb/d). In turn, the fall in the production of the OPEC+ grouping, by 1.3 mb/d that year, was led by the Russian Federation (-1.0 mb/d), and in North America, the United States (-0.7 mb/d) more than Canada (-0.2 mb/d). These downward adjustments in production were part of a historic agreement between leading producer countries in response to falling hydrocarbons demand and prices during the pandemic.

In Latin America and the Caribbean (22 countries), the total supply of oil for domestic use fell from 2.154 to 1.554 billion barrels of oil equivalent (BOE) in the past 20 years, or by 27.9%, while production declined by 703 million BOE, or 19.2%, in the same period, from 3.663 to 2.960 billion BOE. There was a significant 196 million BOE drop in imports (51.7%), which brought them down to 183 million BOE in 2020. The trend was less marked in the case of exports, with a reduction of 280 million BOE, or 14.8%, to 1.606 billion BOE in 2020.[9] In turn, the region's oil surplus —the difference between production and consumption— which was 3.4 mb/d in 2000 after peaking at 4.1 mb/d in 2004, began a decline that steepened as of 2016. It fell to 0.7 mb/d in 2019, then to 0.9 mb/d in 2021. The decline in the surplus principally reflects the downward trend in supply, since demand, despite having peaked at 8.5 mb/d in 2013, began to decrease to levels similar to those of the early 2000s (see table VI.2).

8 In 2016, OPEC formed the grouping known as OPEC+ with 10 other top oil-producing nations: Azerbaijan, Bahrain, Brunei Darussalam, Kazakhstan, Malaysia, Mexico, Oman, the Russian Federation, Sudan and South Sudan.

9 It should be noted that the comparison is made between 2000 and 2020, when the pandemic broke out. In the region, the utilization of the total oil supply in 2020 was concentrated in processing (almost 100%), almost entirely by refineries (97%). This situation was no different from that of 2000. See the supply and demand series at the Energy Information System of Latin America and the Caribbean (sieLAC) of the Latin American Energy Organization (OLADE) [online] https://sielac.olade.org/WebForms/Reportes/ReporteOD.aspx?subsectorId=0&or=720&ss=2&v=1.

Table VI.2
Latin America and the Caribbean (selected countries): oil reserves, production and consumption
(Millions of barrels and percentages)

	2000	2005	2010	2015	2019	2020	2021
Reserves *(mb)*	120 642	114 291	330 498	332 535	330 099	329 432	n. d.
Global share *(Percentages)*	9.3	8.3	20.2	19.7	19.0	19.0	n. d.
Production *(mb/d)*	10.1	11.1	10.4	10.6	8.2	7.8	7.8
Global share *(Percentages)*	13.6	13.6	12.5	11.5	8.7	8.9	8.7
Consumption *(mb/d)*	6.8	7.1	7.9	8.2	7.5	6.4	7.0
Global share *(Percentages)*	8.8	8.5	9.1	8.9	7.7	7.2	7.4
Surplus *(mb/d)*	3.4	4.0	2.5	2.3	0.7	1.4	0.9

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, *bp Statistical Review of World Energy 2022: 71st edition*, 2022 [online] http://www.bp.com/statisticalreview.

Note: Latin America and the Caribbean includes the countries grouped in South and Central America according to the definition used by BP (2022), plus Mexico; n.d.: not determined; mb: million barrels; mb/d: million barrels per day.

These variations, together with the rate of consumption of derivative products (or refined products), gradually reduced the region's trade surplus in fossil fuels. This trend in the fossil fuel trade balance bears witness to the reprimarization process that has been occurring for some years in the region (ECLAC, 2013). For example, the average oil trade surplus is estimated at 0.8 mb/d between 2019 and 2021, which is consistent with the surplus shown in table VI.2. However, in the disaggregation between crude oil and refined products, the former represent 85.9% of exports and the latter, 14.1%. In imports, crude oil represents 10.8% and refined products, 89.2%. Moreover, refining capacity has remained virtually unchanged at 7.6 mb/d since 2000, as Brazil's added capacity (of 0.5 mb/d) largely offset the decline in other countries and capacity utilization decreased from 83.6% to 56.2% due to the lower volume of oil processed, particularly by the Bolivarian Republic of Venezuela (-0.9 mb/d) and Mexico (-0.5 mb/d).[10] As a bloc, the region depends on imports to cover its domestic consumption of refined products. Based on the volume of crude oil exported, it could replace only 60% of imports of these products imported from outside the region. This is only in theory, since, in practice, the configuration and complexity of a refinery conditions its production, from heavy fractions to high-quality refined products. However, Materán Sánchez (2018) points out that one of the main difficulties of the region's refining industry today is that what its refineries produce does not match the demand for fuel. This causes product shortfalls in the domestic market that must be met via imports, such as diesel and gasoline.

[10] Within the region, Brazil is the country with the highest refining capacity (2.30 mb/d) and number of active refineries (17). Mexico follows (with 1.56 mb/d and six refineries, although two will be added, since in 2021 it bought another refinery in the United States to serve the Mexican market, given its proximity to the border, and opened a new one in the country, which each added 0.34 mb/d of capacity), the Bolivarian Republic of Venezuela (1.30 mb/d and six refineries, although it also has nine outside the country, but these serve the markets where they are located, with an additional capacity exceeding 1.15 mb/d), Argentina (0.58 mb/d and nine refineries), Colombia (0.42 mb/d and five refineries), Peru (0.28 mb/d and seven refineries), Chile (0.24 mb/d and three refineries), Ecuador (0.18 mb/d and three refineries), Trinidad and Tobago (0.18 mb/d and one refinery) and Cuba (0.70 mb /d and three refineries). The capacity utilization of refineries varies in these countries due to different factors, in addition to the configuration and complexity of the facilities, which conditions what they are used for. A similar situation occurs in countries with refining capacities of under 0.10 mb/d: Costa Rica, Dominican Republic, El Salvador, Guatemala, Jamaica, Nicaragua, Plurinational State of Bolivia, Suriname and Uruguay.

Table VI.3
Latin America and the Caribbean (selected countries): oil processed, refining capacity and capacity utilization, 2000–2021
(Millions of barrels per day and percentages)

	2000	2005	2010	2015	2019	2020	2021
Oil processed *(mb/d)*	6.2	6.4	6.0	5.4	4.1	3.9	4.3
Global share *(Percentages)*	9.2	8.6	7.9	6.8	5.0	5.1	5.4
Refining capacity *(mb/d)*	7.5	7.7	7.8	7.7	7.7	7.9	7.6
Global share *(Percentages)*	9.0	8.7	8.3	7.9	7.5	7.7	7.5
Capacity utilization *(Percentages)*	83.6	83.2	76.8	70.4	53.4	49.2	56.2

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, *bp Statistical Review of World Energy 2022: 71st edition*, 2022 [online] http://www.bp.com/statisticalreview.

Note: Latin America and the Caribbean includes the countries grouped in South and Central America according to the definition used by BP (2022), which includes Mexico and excludes Curaçao and other territories making up the former Netherlands Antilles; mb/d: million barrels per day.

The decrease in production has not occurred across the board during the period examined, but only in the cases of Argentina (-0.2 mb/d), Mexico (-1.5 mb/d) and the Bolivarian Republic of Venezuela (-2.5 mb/d), while Brazil saw a notable rise (1.7 mb/d). The drop in production in the aforementioned countries has to do with the maturity of deposits, low level of investment and also, in the case of the Bolivarian Republic of Venezuela, a prolonged political, social and economic crisis and, since 2017, sanctions imposed by the United States.[11] However, different types of potential non-conventional deposits have emerged in some of these countries, such as Vaca Muerta in Argentina.[12] Even so, it is doubtful whether these fields can enter mass production, in view of the convergence of domestic and external factors such as the particular challenges or gaps facing a given country and its cyclical and structural agendas. In the case of Argentina, for example, domestic socioeconomic emergencies have created political reasons to postpone the application of real prices for energy resources, which would mean adjusting prices, ending generalized subsidies and establishing clear, robust incentives for investment in the industry. All this is in the context of a global oil market conditioned by geopolitics and subject to pressure from global agendas driving sustainable development and the effort to combat climate change.

3. Natural gas

At first glance, Latin America and the Caribbean appears to have abundant resources in relative terms, with an estimated reserves-to-production ratio of 42.4 years. However, this figure includes the Bolivarian Republic of Venezuela, the country with the largest endowment, with 264.1 years of availability. Without Venezuela, the ratio falls to 10.8 years, an average figure that could be interpreted as a warning of supply issues in the short or medium term in the absence of new exploration efforts.[13] Although the reserves-to-production ratio in years is comfortable for the region overall, these reserves represent only 4.3% of world reserves, distributed between the Bolivarian Republic

11 In August 2017, the United States imposed financial sanctions against the Government of the Bolivarian Republic of Venezuela and Petróleos de Venezuela, S.A. (PDVSA) and, in January 2019, imposed an oil embargo (blocking operations between United States companies and PDVSA) (see [online] https://www.state.gov/venezuela-related-sanctions/).

12 Other countries in the region also have non-conventional hydrocarbon deposits, with different degrees of development and importance with respect to reserve levels: Brazil, Colombia, Mexico and Bolivarian Republic of Venezuela. Chile, Paraguay, Plurinational State of Bolivia and Uruguay have technically recoverable resources (IEA, 2015).

13 However, gas reserves unrelated to oil production represent only around 20% of the total. The reserves-to-production ratio for the region and for the Bolivarian Republic of Venezuela were calculated based on the averages of natural gas production for 2019–2021, which were estimated at 23.7 and 190.5 bcm, respectively (24.0 and 182.0 bcm, respectively, in 2021) (BP, 2022).

of Venezuela (3.3%) and the rest of the countries of the region (1.0%). The region's production was 4.5% of the global total in 2021, which was equivalent to 182.6 billion cubic metres (bcm); although this represented a rise in production since the start of the millennium, the same cannot be said of its global share. Regional production was 135.1 bcm in 2000, or 5.6% of the world total; it peaked at 227.3 bcm in 2014, and 6.6% of the global total, then gradually declined to the 2021 level (see table VI.4).

Table VI.4
Latin America and the Caribbean (selected countries): natural gas reserves, production and consumption, 2000-2021
(Billions of cubic metres and percentages)

	2000	2005	2010	2015	2019	2020	2021
Reserves	7 614	7 154	8 457	8 504	8 117	8 076	n. d.
Global share *(Percentages)*	5.5	4.7	4.7	4.7	4.3	4.3	n. d.
Production	135.1	183.7	211.6	226.0	203.1	185.8	182.6
Global share *(Percentages)*	5.6	6.7	6.7	6.4	5.1	4.8	4.5
Consumption	134.2	179.9	213.3	258.6	250.8	230.9	251.6
Global share *(Percentages)*	5.6	6.6	6.8	7.4	6.4	6.0	6.2
Surplus	0.9	3.8	-1.7	-32.6	-47.6	-45.1	-69.0

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, *bp Statistical Review of World Energy 2022: 71st edition*, 2022 [online] http://www.bp.com/statisticalreview.

Note: Latin America and the Caribbean includes the countries grouped in South and Central America according to the definition used by BP (2022), plus Mexico; n. d.: not determined.

This pattern is related to developments in international trade in liquefied natural gas (LNG) and the energy transition, which have to an extent driven a global trend towards greater use of LNG (and, consequently, less use of coal) to reduce carbon dioxide (CO_2) emissions in power and heat generation, although, as of 2021, these efforts had not yet resulted in a lower level of emissions.[14] Except in 2009 and 2020, global natural gas production has grown almost uninterruptedly since 2000, from 2.40 to 4.04 trillion cubic meters, which represents an increase of 68.2% over the period. Between 2000 and 2021, production increases of over 100 bcm occurred in the United States, which became the world's leading producer (from 519 to 934 bcm); the Islamic Republic of Iran, which became the world's third largest producer in the world (from 56 to 257 bcm); China, whose natural gas exploitation expanded significantly, making it the fourth largest producer in the world (from 27 to 209 bcm); the Russian Federation, which slipped to second place (from 537 to 702 bcm); Qatar (from 26 to 177 bcm), and Australia (from 31 to 147 bcm).

The expansion of natural gas consumption in the United States electricity sector is an example of the patterns mentioned in relation to global consumption and the foregoing observations regarding the development of international LNG trade and the energy transition, and this has been boosted even more by the closure and conversion of coal-fired power plants.[15] A similar trend was seen in several countries, mainly in Europe, with the global increase in electricity generation from natural gas and renewable energy sources. However, this trend has slowed recently in the case of natural gas, owing to the relative increase in its price compared to coal. This began to occur in 2021, due to the rapid recovery of economies and electricity demand after the height of the

[14] Global carbon dioxide (CO_2) emissions from energy combustion and industrial processes rebounded in 2021 to reach their highest annual level in history. For more information see IEA (2022a).

[15] According to information from the Energy Information Administration of the United States, 121 coal-fired power plants in the United States were converted to burn other types of fuels between 2011 and 2019. Of these, 103 were converted to natural gas plants or replaced by new natural gas plants. At the end of 2010, the United States had 316.8 gigawatts (GW) of coal-burning capacity, but by the end of 2019, 49.2 GW had been retired, 14.3 GW had been converted (the boilers) to burn natural gas and 15.3 GW had been replaced by natural gas combined cycle plants. The switch from coal to natural gas plants was driven by stricter emissions standards, low natural gas prices, and new, more efficient natural gas turbine technology (IEA, 2020).

pandemic in 2020 (when the various containment measures had been put in place).[16] Prices continued to rise during 2022, owing to the war between the Russian Federation and Ukraine, which caused interruption in the piped supply of natural gas to Europe from the Russian Federation, resulting in a drop in total consumption of gas in that region —although there was record consumption of LNG— and creating tensions in global natural gas markets.

The changes that have occurred in international trade flows of LNG may have repercussions for the region and, in particular, on LNG exports, especially by Trinidad and Tobago, possibly for Brazil and hypothetically for Argentina. International LNG trade grew from 140.5 bcm to 516.2 bcm, or by 267.5%, between 2000 and 2021, surpassing trade via gas pipelines in 2020, which rose from 387.3 BCU to 505.6 BCU in the same period —that is, an increase of just 30.5%. Gas trade via pipelines saw declines in 2009, between 2012 and 2014 and, finally, in 2019 and 2020. Conversely, LNG trade contracted only in 2012. Growth in LNG trade has slowed in recent years, owing to the start-up or increase in capacity of several liquefaction plants in Australia, the United States, the Russian Federation, and, in the first decade of the 2000s, in Qatar. This increase in LNG export infrastructure was also accompanied by the development of import infrastructure —for example, regasification plants— in large consumer countries, such as China, India, Japan and the Republic of Korea, which have absorbed the increasing supplies (IEA, 2019a).

In Latin America and the Caribbean, natural gas consumption has historically been important in several countries and represents an increasingly large portion of the energy supply. In the composition of the total natural gas supply of the region (22 countries), production grew from 1.4 to 1.553 billion BOE, or 11%, between 2000 and 2020, while, in the trade balance, imports increased from 60 to 476 million BOE, far exceeding exports, which increased from 68 to 201 million BOE in the same period. As a net result, the total supply of natural gas grew from 1.116 to 1.535 billion BOE, or by 37.5%, in the period under analysis, but the increase was mainly in imports, with production taking second place.[17] The region's natural gas surplus was almost 1 bcm in 2000 and this remained relatively stable until 2009, then began to gradually deteriorate to reach a deficit of 69 bcm in 2021, representing 37.8% of that year's production. This shows the need for the region to import gas to cover a consumption demand that has been increasing and peaked at 261.9 bcm in 2017, albeit in 2021 the recorded consumption was only 4% lower than that figure (see table VI.4).

Regional production is still concentrated in a few countries, although less so than at the start of the millennium: Argentina, Bolivarian Republic of Venezuela, Brazil, Mexico, and Trinidad and Tobago together represented just over 90% of production in 2000, and 77% in 2021. Other countries, such as Colombia, Peru and the Plurinational State of Bolivia, saw their shares rise vis-à-vis lower production by Mexico and the Bolivarian Republic of Venezuela and the still very modest expansion of the industry in Argentina. On the consumption side, these five countries still account for around 85% of regional

[16] In 2021, total thermal electricity generation increased by almost 6% —980 terawatt hours (TWh)— worldwide, the largest growth recorded since 2010. On the one hand, gas-generated electricity, hampered by high prices, increased only 2% globally, which offset the decline in 2020. On the other hand, after declining in 2019 and 2020, coal-fired electricity generation increased by around 9% and reached a new all-time high. Coal covered more than half of the additional demand in 2021, so in absolute terms it grew faster than renewables for the first time since 2013 (IEA, 2022b).

[17] The comparison is made between 2000 and 2020, the year the pandemic began. In the region, the use of the total oil supply in 2020 was distributed between processing (44%), final consumption (30%) and own consumption (20%). Compared to 2000, the share of processing increased by 4 percentage points to the detriment of final consumption. Within processing, the largest share was accounted for by refineries (67%), then to gas plants (20%), self-producers (12%) and others (1%). In relation to the year 2000, refineries and self-producers increased their share by 23 percentage points and 9 percentage points, respectively, while the share corresponding to gas plants decreased by 27 percentage points and that of others, by 4 percentage points. See more information in OLADE, "Supply and demand series", Energy Information System of Latin America and the Caribbean (sieLAC) [online] https://sielac.olade.org/WebForms/Reportes/ReporteOD.aspx?subsectorId=0&or=720&ss=2&v=1.

demand, although their share shifted between 2000 and 2021. The share in regional consumption of Argentina, Bolivarian Republic of Venezuela, and Trinidad and Tobago decreased, which was offset by increases in the share of Brazil and Mexico. Be this as it may, the use and penetration of natural gas as a fuel for the energy transition, mainly for electricity generation, have advanced to a greater or lesser extent in the countries of the region (Di Sbroiavacca and others, 2019). In terms of the production–consumption ratio, Argentina went from being an exporter to an importer, while Brazil and, very markedly, Mexico saw their imbalance and vulnerability increase. The Bolivarian Republic of Venezuela, which has the largest nominal reserves in the region, resorted to occasional imports from Colombia, although both countries have maintained a balance between production and consumption. The Plurinational State of Bolivia (via gas pipelines), Peru and Trinidad and Tobago (both via LNG), register large exportable surpluses.

The different evolution and position of the various countries has left the region's trade balance with a constant, worrying downtrend since the end of the first decade of 2000, reaching a deficit of 69.8 bcm in 2021. Of this, 84% reflects the pipeline gas trade deficit between Mexico and the United States, as pipeline gas flows between Argentina, Brazil and the Plurinational State of Bolivia are intraregional (from the Plurinational State of Bolivia), and 16% reflects the region's LNG trade deficit, given that exports from Peru and Trinidad and Tobago together represent only 54% of imports from Argentina, Chile and Brazil (and other countries in the region) from other regions.

One of the factors underlying this regional pattern is the state of progress of gas pipelines, since little has changed in recent years with regard to binational or intraregional interconnections, but interregional connections have developed between Mexico and the United States. In addition, no new liquefaction plants have been built, but regasification plants have been built for LNG.[18] According to Di Sbroiavacca and others (2019), South America has 16 gas pipelines in the integration category, with an installed transportation capacity of 121 million cubic metres per day, although the utilization factor is very low.[19] Mexico already had double this capacity on the import capacity side alone, which was 311 million cubic metres per day in mid-2019 (SENER, 2019). Regarding export infrastructure, the region continues to have two liquefaction plants in operation since 2010 (one in Peru and the other in Trinidad and Tobago), and one that stopped operating in 2020, after coming on stream in 2019 (in Argentina). Conversely, the import infrastructure, consisting of regasification plants, comprises 18 terminals in operation (two in Argentina, five in Brazil, two in Chile, one in Colombia, one in the Dominican Republic, two in Jamaica, four in Mexico, and one in Panama), but 10 of these came on stream after 2010.

The dynamics of LNG imports by the main importing countries have been and continue to be a consequence of the breakdown of integration processes as exporting countries' production has failed to rise enough to meet ever-increasing consumption. Among the producers, Argentina, Brazil and Mexico went from not importing any LNG in 2005 to importing 1.9, 2.8 and 6.9 bcm, respectively, in 2010 and, then, 3.7, 10.1 and 0.9 bcm in 2021. Conversely, Peru, since its liquefaction plant began operation in 2010, went from exporting 1.9 bcm that year to exporting 3.5 bcm in 2021, and Trinidad and Tobago, with the expansion of its plant, by adding three trains between 2002 and 2006, also increased LNG exports from 4.0 bcm in 2000 to 19.6 bcm in 2010 and 9.1 bcm in 2021. Meanwhile, importing countries, such as Chile and other countries in the region, increased their LNG imports from 3.1 bcm to 4.5 bcm and from 1.4 bcm to 6.1 bcm,

18 Between 2013 and 2018, Mexico's natural gas import capacity through interconnections with the United States more than tripled, with the commissioning of eight additional interconnections in that period (SENER, 2019).

19 The region's bilateral natural gas interconnections, although not all of them are currently operational, are between Argentina and the Plurinational State of Bolivia, between Argentina and Chile, between Argentina and Brazil, between Argentina and Uruguay, between the Plurinational State of Bolivia and Brazil and between Colombia and the Bolivarian Republic of Venezuela.

respectively, between 2010 and 2021. In total, the region's imports increased by 66% between 2010 and 2021—from 15.2 to 25.3 bcm— and its exports fell by 41% —from 21.4 to 12.6 bcm.

Thus, both natural gas from conventional resources and the incipient development of gas from non-conventional resources have far to go to cover the needs arising from the increased consumption of several producing countries and, still more, to be able to respond to intraregional trade. For example, in the case of Argentina, the exploitation of tight gas and shale gas has been growing since 2012 and has offset the decline in conventional gas production. Some surpluses have been exported since 2016, but in the annual balance these are lower than the volumes that are still imported. In the case of Brazil, the largest domestic supply will come from the development of infrastructure to connect pre-salt production. In both cases, the potential is large enough not only to supply the respective domestic and regional demands, but even to export to other markets. The Plurinational State of Bolivia, the Bolivarian Republic of Venezuela and, perhaps, Colombia also have potential to reverse the region's net importer situation. This would take large investments, however, and also depends on other factors, such as those mentioned in the case of oil, where each country's challenges, gaps and cyclical and structural agendas all come into play.

B. Economic impacts of hydrocarbons: investment, international trade and tax revenues

1. Evolution of commodity prices and energy investments worldwide

International fossil fuel prices saw large variations between 2000 and 2022, with rising and falling cycles within a significant range of variation. For example, the minimum annual per barrel price of Brent crude oil was US$ 24.40 in 2001, US$ 112.00 in 2011 (its peak) and US$ 99.80 in 2022. Meanwhile, in Europe natural gas fluctuated between US$ 3.10 per million British thermal units (Btu) in 2002 and US$ 40.30 per million Btu in 2022 (see table VI.5 and figure VI.1).

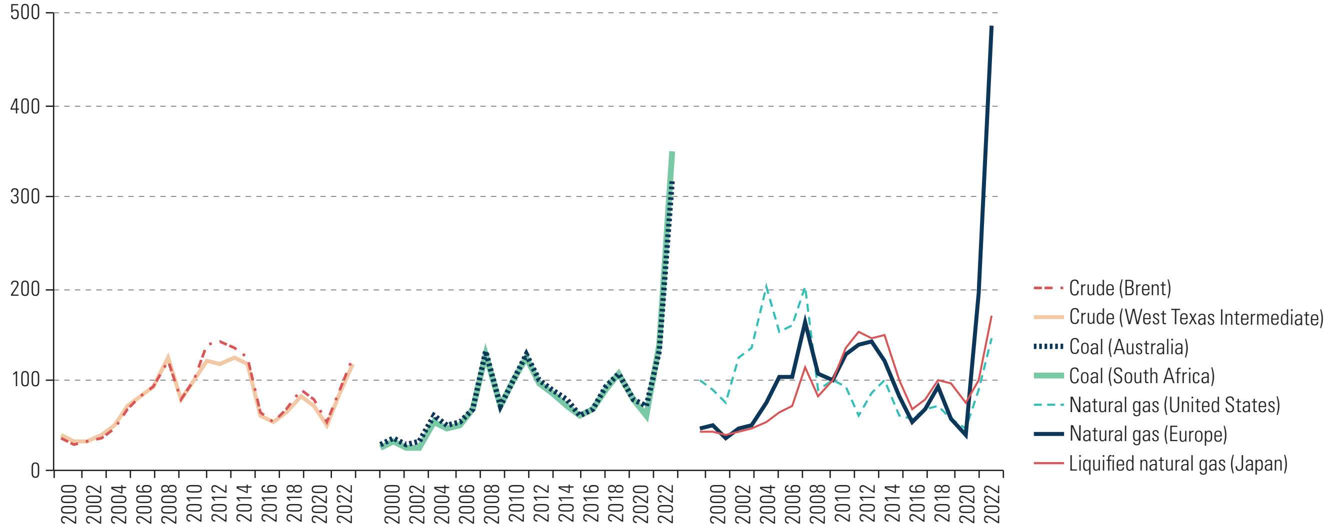
Table VI.5
International prices of fossil fuels, annual series, 2000–2022
(Dollars at current prices)

Year	Crude oil *(Dollars per barrel)*		Natural gas *(Dollars per Btu)*		Liquid natural gas	Coal *(Dollars per ton)*	
	Brent	WTI	United States	Europe	Japan	Australia	South Africa
2000	28.3	30.3	4.3	3.9	4.7	26.3	26.6
2005	54.4	56.4	8.9	6.3	6.0	47.6	46.2
2010	79.6	79.4	4.4	8.3	10.8	99.0	91.6
2015	52.4	48.7	2.6	6.8	10.9	58.9	56.7
2019	64.0	57.0	2.6	4.8	10.6	77.9	71.9
2020	42.3	39.3	2.0	3.2	8.3	60.8	65.7
2021	70.4	68.0	3.9	16.1	10.8	138.1	119.8
2022	99.8	94.4	6.4	40.3	18.3	344.9	291.5
Minimum (year)	24.4 (2001)	25.9 (2000)	2.0 (2020)	3.1 (2002)	4.3 (2002)	25.3 (2002)	26.0 (2002)
Maximum (year)	112.0 (2012)	99.6 (2008)	8.9 (2005)	40.3 (2022)	18.3 (2022)	344.9 (2022)	291.5 (2022)

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, *World Bank Commodity Price Data (The Pink Sheet)*, several editions.

Note: Btu: British thermal unit; Minimum (year): minimum annual price recorded in the period 2000–2022; Maximum (year): maximum annual price recorded in the period 2000–2022.

Figure VI.1
International fossil fuel price indices, 2000–2022
(Base year 2010=100)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, *World Bank Commodity Price Data (The Pink Sheet)*, 4 January 2023.
Note: Price indices were calculated from the annual series in current dollars.

In short, fuel prices rose sharply during the commodity boom and then began to decline. Despite a slight recovery in 2018, they fell again significantly in 2020, during the first year of the pandemic, which is largely explained by the contraction in demand and economic activity due to containment measures (such as lockdowns and restrictions on movement).[20] Since 2021, amid progress in vaccination plans and the consequent lifting of containment measures, rapid economic recovery caused a considerable jump in prices which gained even faster momentum from March 2022 owing to the war between the Russian Federation and Ukraine.

At the same time, international prices in current dollars of energy products showed a positive trend in the period 2000–2022. For example, the price of crude oil, both Brent and West Texas Intermediate (WTI), more than tripled (more than doubling in 2021 alone). Variations in the price of natural gas depended on the market: in the United States it rose almost 50% (but decreased more than 10% up to 2021) and in Europe, it rose more than ten-fold (more than quadrupling up to 2021). The price of coal increased the most, but it also varied depending on the market: in Australia it rose by a factor of more than 13 (more than 5 up to 2021) and in South Africa, by over 10 (more than 4 up to 2021). It should also be noted that, with the exception of natural gas in the United States, the prices of energy products were also positive in constant 2010 dollars over the period, although logically less so than in current dollars (World Bank, 2023).

Price trends demonstrate the volatility of fossil fuel markets, particularly during global crises. The greatest uncertainty and turbulence, along with a significant resultant rise in prices, thus occurred during the war in Ukraine. As noted earlier, the Russian Federation is a major player in the global fossil fuel market, and the responses of countries and

20 In the case of the price of WTI crude oil, the market anomaly caused prices in the futures market to turn negative. This slump, although purely speculative, caused alarm worldwide in April 2020. The drop in demand amid the advance of the pandemic and the implementation of containment measures generated an oversupply of crude oil that led to an increase in reserves, full utilization of storage capacities and high management costs, as major producers, such as Saudi Arabia and the Russian Federation, failed to agree quickly on quota cuts.

blocs have repercussions that increase market vulnerability.[21] As occurred during the oil crises of the 1970s, this speaks to the geopolitical nature of the industry, given its key role for current energy systems worldwide. However, the situation could change with greater use of renewable and clean energies for the transition towards more sustainable and secure energy systems, given the growing pressure to meet the global agendas for sustainable development and the fight against climate change and, in the current context, in order to provide an energy security framework.[22]

In this regard, globally, the pace of investments in energy —the supply of oil, natural gas, coal and low-carbon fuels; electricity generation, and end-use sectors, including energy efficiency in the latter group— is driven by the prices of energy products. This also occurred in the period reviewed. Energy investments rose progressively from 2000 on, with the exception of 2009, peaking in 2014.[23] Thereafter they fell markedly owing to the fall in the price of oil until 2017, rose slightly in 2018 and 2019, but fell again in 2020, with a 10% drop compared to 2019. In 2021, energy investment climbed by 14.2% and exceeded US$ 2.2 trillion (2021 dollars). A further increase of 8.5% is estimated to have occurred in 2022, to US$ 2.4 trillion (2021 dollars), well above pre-pandemic levels (IEA, 2022c).

This recovery of energy investments globally in recent years appears to be driven by the generation of electricity from renewable sources and the end-use sectors, given that the part of investments in the fossil fuel supply —prospecting, exploration, production and decommissioning (upstream), transportation and storage of crude oil and natural gas (midstream) and refining or processing of crude oil and natural gas, distribution, sale and final use (downstream)— and in generation accounted for over 60% of energy investments until 2016, but that share fell thereafter, to reach 41% in 2021 and an estimated 40% in 2022. This is explained by a fall in investments in fossil fuels: between their 2014 peak and 2022, they fell by almost 36%, despite the 15.9% recovery in 2021 and even an estimated increase of 7.2% in 2022. Otherwise, average investment in the period 2019–2022 compared with that of the previous period (2015–2018) shows a fall of 15.2%. Conversely, investments in renewable energies (low-carbon fuels and electricity generation) and in the end-use sectors rose by 31.6% and 21.3%, respectively, so total investments in energy grew by 1.1%. Investment in fossil fuels in 2022 thus came to US$ 0.95 trillion (at 2021 prices) and were 5% lower than the 2019 level, before the pandemic (IEA, 2022c).[24]

Upstream investment in oil and gas has historically represented the largest share of investments in fossil fuel supply. It is also what has explained the fall in these investments and in total energy investments. Between its 2014 peak at US$ 0.9 trillion and the estimate for 2022, it declined by about 53%, since the increase in 2021 and the estimate for 2022 were each 8.7%. If the average investment for 2019–2022 is compared to that for 2015–2018, it shows a decline of 23.7%, with this fall clearly more marked than other supply-side investments (such as in midstream and downstream activities and generation), in both relative and absolute terms. Thus, upstream investment reached some US$ 0.4 trillion in 2022 (in 2021 dollars), 17% below the level in 2019 (IEA, 2022c).

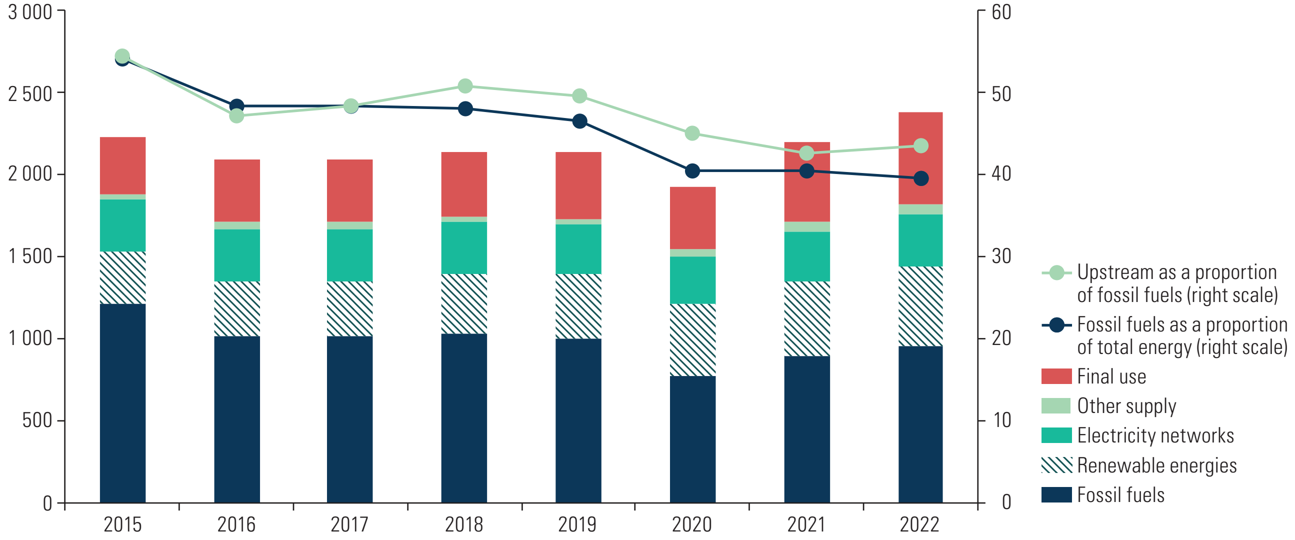
21 The Russian Federation is the third largest crude oil producer in the world. It competes for first place with Saudi Arabia and the United States. It is also the world's second largest producer of natural gas, behind the United States. With its large export capacity —of oil and gas pipelines— in 2021, it supplied buyers in Europe with 51% of their crude oil imports and 45% of their natural gas imports. For more information see IEA (2022e).

22 Energy security is one of the objectives of the global agendas on sustainable development and the fight against climate change, which establish that energy must be clean, affordable, sustainable and reliable. However, energy security has acquired even greater dimensions in the current situation, due to the war in Ukraine and the energy crisis.

23 As an example of the trends in energy investments between 2000 and 2014, capital expenditures on fossil fuel supply alone more than tripled in real terms (in 2015 dollars), then fell by 18.2% in 2015 (IEA, 2016).

24 When disaggregating by fuel and only in relation to the supply chain (not considering generation), the estimated investment in 2022 compared to the pre-pandemic level of 2019 would be 7% lower in oil and natural gas and 11% higher in coal (mainly attributable to China). In fossil fuel generation, the estimated investment in 2022 compared to 2019 was 5% higher in oil and gas and 23% lower in coal (IEA, 2022b).

Figure VI.2
Energy investments worldwide, 2015–2022
(Billions of dollars at 2021 prices and percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Energy Agency (IEA), World Energy Investment 2022, Paris, 2022 [online] https://www.iea.org/reports/world-energy-investment-2022.

Note: The 2022 figures are estimates. The category of fossil fuels (oil, natural gas and coal) includes investments in prospecting, exploration, production and decommissioning (upstream), transportation and storage of crude oil and natural gas (midstream), and refining or processing of crude oil and natural gas, distribution, sale and final use (downstream), as well as generation from these sources. The renewable energy category includes investments in low-carbon fuels and generation from these sources. Other supplies include investments in nuclear generation, storage and others. In the ratio between upstream investment and fossil fuels, upstream investment refers only to oil and natural gas.

Patterns of investment in fossil fuels point to the scenario of tension that was emerging in these markets and was worsened by the cascading crises caused, first, by the pandemic and, later, the war in Ukraine. Extreme price volatility and rising costs are the main factors underlying this evolution in the period reviewed and the resulting tension. In particular, the rise in oil and gas prices (with peaks and then heavy falls) and the cost of upstream investment, which followed a similar trend, surging by over 40% between 2005 and 2014, although in 2016 it abruptly returned to the 2005 level and remained there until 2020. It only began to rise in 2021, owing to inflation of cost components (equipment and machinery, labour and materials) (IEA, 2022c). When fuel prices fall, companies adopt different strategies to adjust their spending (such as capital discipline, debt reduction and greater efficiency), which has an impact on exploration expenditures and, therefore, on the discovery of (conventional) resources.[25]

In this regard, exploration expenditures as a percentage of total upstream investment in oil and gas worldwide decreased from around 23% in 2000 to 15% in 2005. This share then increased to around 20% towards 2010, and then gradually fell until 2021, and has remained under 10% since 2020.[26] This pattern of exploration investment has impacted discoveries of conventional resources, which gradually fell after 2010 and, since 2013, have been below 15 billion BOE per year. During the period 2000–2004,

25 In the case of conventional resources, it also affects production costs. For non-conventional resources —for example, shale oil or gas, tar sands oil, extra-heavy oil, low-permeability tight sand gas, or coal-bed methane, which are relatively abundant on land and for which there is no formal exploration process as such (or no need for exploration in the usual sense)— extraction or production requires specialized techniques (for example, fracking) and expenditures are grouped into drilling and pumping operations (injection and extraction) of fluids.

26 However, this trend could be changing to go by the increase in exploration seen in 2021 and estimated for 2022 amid fossil fuel price rises, as well as in components of upstream investment costs. This is due in particular to the cost of materials, given that drilling equipment rates and labour costs came down between 2019 and 2021, for both conventional and non-conventional resources (shale) (IEA, 2022c).

the annual average was estimated at 27 billion BOE; from 2005 to 2009, at 33 billion —with a peak in 2006 of over 50 billion (IEA, 2019b)—; from 2010 to 2014, at 29 billion; from 2015 to 2019, at 14 billion, and during 2020 and 2021, at 12 billion and 9 billion BOE, respectively (IEA, 2022c).[27] However, since 2010, the drop in discoveries has also been related to the boost in non-conventional resources. Investment in non-conventional assets represented 4% of total upstream investment between 2000 and 2009, then rose to 17% between 2010 and 2015, and exceeded 20% between 2017 and 2019. Although it fell back to under 15% in 2020, in 2021 it rose above 18% and is estimated to have returned to its pre-pandemic level in 2022 (IEA, 2010 and 2022c).[28]

In short, upstream investment and the addition of reserves have largely reflected trends in oil and natural gas prices. This is borne out by the oil and natural gas reserves recorded by BP (2022), which grew by 25.8% and 30.4%, respectively, between 2000 and 2010. They then grew much more slowly between 2010 and 2020, at between 5.8% and 4.5%. North America and Asia and the Pacific (including China) have accounted for almost half of upstream investment since 2019 (36% and 15% of the total, respectively). These are followed by the Middle East (13%) and Eurasia (12%, including the Russian Federation) but, after the pandemic, only Asia and the Pacific and the Middle East have exceeded 2019 investment levels, mainly through investment by State oil companies. With respect to coal, supply chain investment has held steady, mainly owing to China and, to a lesser extent, India and exporting countries (Australia, Colombia, Indonesia and South Africa). China not only surpassed its pre-pandemic investment in coal supply in 2021, but reached a new high in 2022, when it accounted for more than two thirds of global investment in coal since 2019 (69%). However, based on BP (2001 and 2022), reserves decreased by 34.5% between 2000 and 2020.

A combination of factors influences energy investments today and may condition their trends into the future. High prices, cost inflation, energy insecurity and economic uncertainty, within a framework of global agendas whose objectives include the transition to clean, accessible, affordable, sustainable and reliable energy, make up a complex situation for decision-making by the main players in the fossil fuel industry who must respond to short-term emergencies or needs that do not necessarily align with long-term objectives. According to IEA (2022c), concerns over energy security and high prices will boost investment in fuels.[29] However, investors remain trapped between different visions of the future, so investments in the production, management and distribution of fuels are essential for an energy system to function well, but the types of investment required vary substantially depending on the scenarios proposed.

Under the IEA Stated Policies Scenario (STEPS), in which the combined demand for oil and gas peaks in 2030, the average annual investment required is around 25% above the investment estimated for 2022. Towards 2030, greater investment will be needed in both new and existing sources of fossil fuel supply (with a focus on conventional projects) to offset the decline in existing deposits, rather than to meet additional demand,

27 It should be noted that sanctioned resources (resources approved for production) behaved similarly to discoveries, although with a softer fall in the period 2015–2019 (with an annual average of 21 billion BOE). In 2021 they were strongly up on 2020, exceeding the average of those four years (with 24 billion BOE, almost 50% of which corresponded to State oil companies in the Middle East). In addition, the share of natural gas within sanctioned resources was increasing with respect to oil and remained on average in the range of 50%–60% from 2000 to 2019. In 2020, it exceeded 60% and, in 2021, 70% (IEA, 2022c).

28 In parallel, since 2000 onshore assets have generally exceeded offshore assets in conventional assets and in terms of share in upstream investment. The exception was the period 2010–2015, when both had a share of 36%, and in 2016, when offshore assets accounted for 41% compared to 38% for onshore assets. However, during the period 2000–2009, onshore assets contributed 46%, compared to 37% for offshore assets. From 2017 to 2022, the average annual share of onshore was 44%, 1.35 times higher than offshore (IEA, 2019b and 2022c).

29 Refers to both fossil fuels and low-emission fuels, such as modern bioenergy (biofuels), low-emission hydrogen, low-emission hydrogen-based fuels, biogas, biomethane and low-emission synthetic methane.

and balance the market.[30] Meanwhile, under the Announced Pledges Scenario (APS), the investment required to 2030 is not far from the Stated Policies Scenario, although combined demand for oil and gas peaks in the mid-2020s (and nearer 2030). This would mean less need for new (conventional) projects than in the Stated Policies Scenario, but some would remain essential to match supply and demand in the late 2020s. Finally, under the Net-Zero Scenario (NZE), policy-driven rises in investment in low-emission fuels dramatically reduce demand for fossil fuels enough to meet it without new oil and gas fields. In this scenario, investment continues in existing fields in the second half of the 2020s, in order to maintain production at the levels required, which involves some low-cost expansions of existing fields, and to minimize the emissions intensity of production (IEA, 2022d).[31]

The visions concerning the future of fossil fuels can be summarized on the basis of these demand projections and investment needs in the different scenarios. The configuration of energy systems today preclude simply ceasing to invest in fossil fuel supply. The change of sources for the energy transition must be gradual and strategically planned in line with the conditions, needs and potential of the energy sector, as well as the political, economic and social environment of each country. In this respect, IEA (2022d) adds that reducing investment in fossil fuel supply in keeping with, for example, the NZE scenario, would not lead to reduction in long-term emissions nor to the energy transition objectives of that scenario. On the one hand, although higher prices could suppress demand, an undifferentiated impact would adversely affect lower-income households. On the other hand, failure to properly coordinate the transition, whereby investment in fossil fuels fell before investment in low-emission fuels rose, would push up prices, possibly for a lengthy period. This could lead to social reactions and short-term policy responses at odds with the long-term emissions reduction, safety and affordability goals of global agendas. To achieve sustained and substantial reductions while reducing future risks of rigidity in fuel markets —for both fossil and low-emissions fuels— policymakers must set appropriate targets and incentives to send strong signals that fossil fuel demand will fall over a determined period of time.

2. Investments in the region's fossil fuel industry and the involvement of State oil companies

The pattern of energy investments in the region exhibited similar ups and downs to the global patterns, but with one major difference, in that the overall trend was clearly negative. According to IEA data (2022c), which does not include Mexico within the region (but in North America), energy investments in the region amounted to US$ 93 billion in 2021 and an estimated US$ 100 billion in 2022 (both figures at 2021 prices), the latter figure being 10% below the 2019 level. Comparing the period 2019–2022 to 2015–2018, average energy investments in the region in the last four years represent less than 5% of the global total and are 9.3% down on the previous period.

This drop in energy investments in the region is explained mainly by investments in fossil fuel supply (upstream, midstream, downstream and generation) and in end-use sectors, which fell by 16.7% and 32.0%, respectively, between 2015–2018

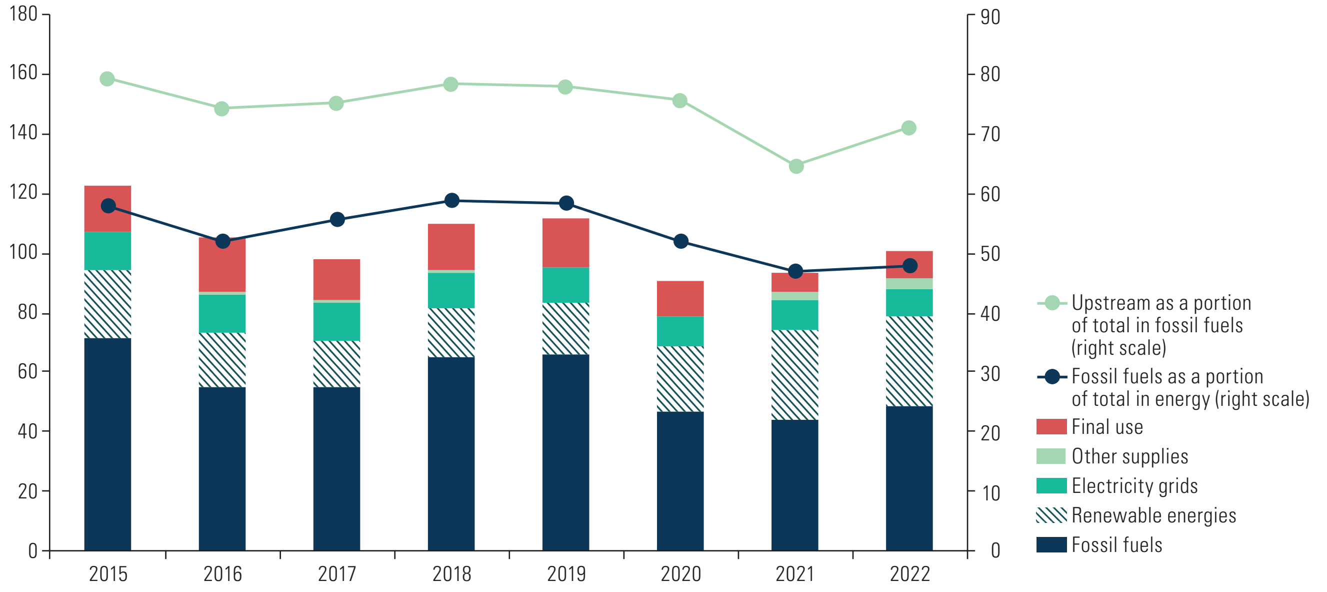
30 In IEA STEPS, almost 90% of investment goes towards offsetting the decline in production at existing fields, rather than meeting additional demand. In this scenario, new conventional projects would be needed to match supply and demand (avoid supply shortages) in the 2020s. It should be noted that investment in coal supply in this scenario is less than half the level of investment in this fuel estimated for 2022 (IEA, 2022c and 2022d).

31 IEA (2022c and 2022d) explains that the problem of methane emissions from leaks must be addressed in order to reduce the intensity of fuel emissions. In relative terms this requires little investment and provides an additional gas supply to global markets and net revenue based on 2022 gas prices. The same reasoning also applies to non-emergency flaring and venting, which occurs when oilfield operators choose to flare gas associated with oil production, or simply release it into the atmosphere, instead of building the equipment and pipelines necessary to capture it. This powerful alignment of cost, reputational and environmental considerations should push the oil and gas industry to adopt a zero-tolerance approach to methane leaks.

and 2019–2022, since the increase in investments in renewables (low-carbon fuels and generation), estimated at 36.0%, is too low in absolute terms to compensate. Investments in the region's fossil fuel supply, which represent on average 5.6% of these investments globally and up to 58% of total energy investments in the region in some of the years between 2015 and 2019, came to less than 48% in 2021 and 2022. In the latter year they amounted to an estimated US$ 48 billion (at 2021 prices), or 27% below the pre-pandemic level (IEA, 2022c).

As at the global level, but in a much higher proportion, upstream investment in oil and gas in the region, which represented on average 8.9% of the world total in the period 2019–2022, has contributed the most to investments in the fossil fuel supply and accounted for the decrease in these and in total energy investments. In fact, over the 2015–2022 period, after reaching US$ 56 billion in 2015 (in 2021 dollars) and contributing 9% of supply investments, upstream investment fell year by year, especially after 2019. It is estimated to have reached US$ 28 billion in 2021, or 65% of supply investments, and US$ 34 billion in 2022 (in 2021 dollars), or 71% of supply investments, 39% less than in 2015 and 33% less than the pre-pandemic level. Again, comparing the average investment in 2019–2022 and 2015–2018 shows a fall of 21.0%, a sharper drop in absolute terms than other investments in fossil fuel supply (such as midstream, downstream and generation) (IEA, 2022c).

Figure VI.3
Latin America and the Caribbean (selected countries):[a] energy investments, 2015–2022
(Billions of dollars at 2021 prices and percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of International Energy Agency (IEA), *World Energy Investment 2022*, Paris, 2022 [online] https://www.iea.org/reports/world-energy-investment-2022.

Note: The 2022 figures are estimates. The category of fossil fuels (oil, natural gas and coal) includes investments in prospecting, exploration, production and decommissioning (upstream), transportation and storage of crude oil and natural gas (midstream), and refining or processing of crude oil and natural gas, distribution, sale and final use (downstream), as well as generation from these sources. The renewable energy category includes investments in low-carbon fuels and generation from these sources. Other supplies include investments in nuclear generation, storage and others. In the ratio between upstream investment and fossil fuels, upstream investment refers only to oil and natural gas.

[a] Refers to a grouping of countries in South America, Central America and the Caribbean according to IEA (2022c), which does not include Mexico.

The pattern of fossil fuel investments in the region described above is partially confirmed —albeit not in a full and statistically consistent manner— by data on foreign direct investment (FDI) and, within FDI, by cross-border mergers and acquisitions. However, as explained below, most upstream investment in oil and gas in the region is led by State oil companies.

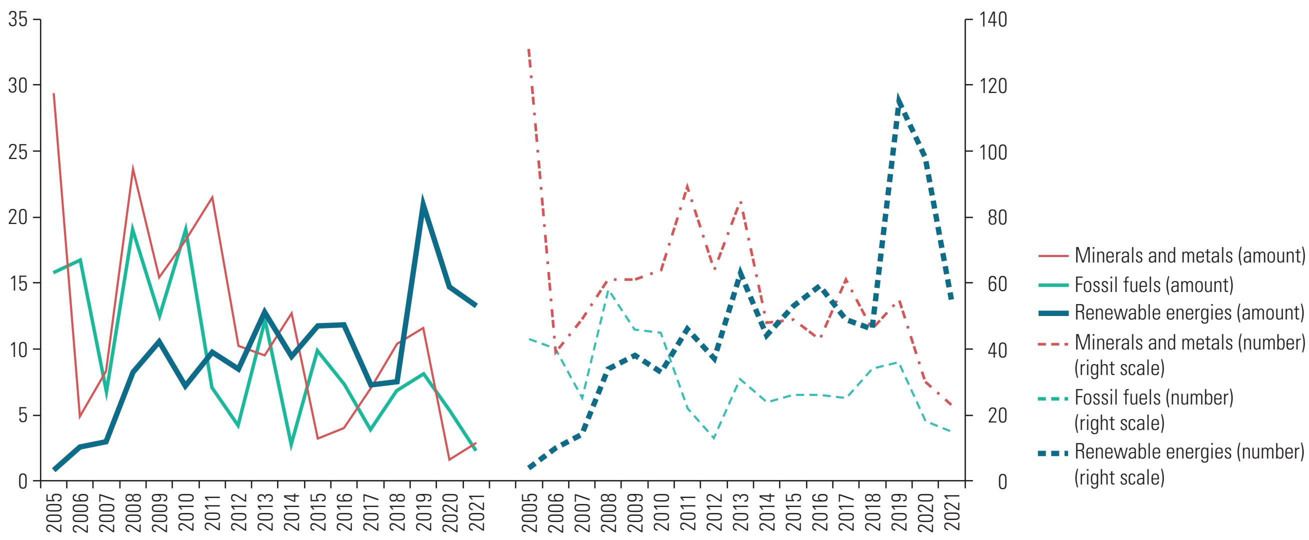
On the one hand, the number of cross-border mergers and acquisitions in the oil and gas sector fell by almost 19%, from 197 to 160, during the period 2012–2018 compared to 2005–2011. However, the sector retained second place after mining, which also saw a drop of 40% in transactions, from 546 to 327, between those periods. Conversely, transactions in the renewable energy sector rose by over 92%, from 53 to 102, between these two periods (ECLAC, 2019). In turn, as a sign of investment appetite, FDI announcements in the development of the fossil fuel sector (coal, natural gas and oil) went from an average of US$ 14.2 billion between 2005 and 2009 to US$ 9.1 billion between 2010 and 2014, and then fell to US$ 7.2 billion between 2015 and 2019. The amounts in 2020 and 2021 were well below these averages, however. A similar although less steep trend occurred in the number of investment announcements. While announcements in mining investment followed a similar pattern to fossil fuel investments, in both amount and number, announcements of investment in renewable energies rose steadily during the five years under review. Since 2011, renewable energy announcements have exceeded those of fossil fuels in amount and number (see table VI.6 and figure VI.4).

Table VI.6
Latin America and the Caribbean: announcements of foreign direct investment (FDI) projects, by selected sector, 2005–2021
(Billions of current dollars and number)

Period	Fossil fuels		Minerals and metals		Renewable energies	
	Amount	Number	Amount	Number	Amount	Number
2005–2009	14.16	42	16.34	68	5.03	20
2010–2014	9.06	27	14.44	70	9.53	45
2015–2019	7.20	29	7.25	51	11.86	64
2020	5.30	18	1.61	30	14.74	98
2021	2.33	15	2.89	23	13.24	55

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Financial Times, fDi Markets.
Note: Annual averages for the five-year periods. The fossil fuel category refers to the coal, oil and natural gas sector depending on the source.

Figure VI.4
Latin America and the Caribbean: announcements of foreign direct investment (FDI) projects, by selected sector, 2005–2021
(Billions of current dollars and number)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Financial Times, fDi Markets.
Note: The fossil fuel category refers to the coal, oil and natural gas sector depending on the source.

One explanation for this shift in investment appetite for renewable energy relative to fossil fuels may lie in the continued decline in the costs of generating electricity with renewable technologies, particularly onshore wind and solar photovoltaics, given the rapid learning curves and technological improvements that brought down total installed costs and increased the plant factor of these technologies (IRENA, 2022).

Likewise, the amounts of fossil fuel investments announced between 2005 and 2021 targeted the main producing countries in the region: Colombia (20.2%), Brazil (15.1%), Mexico (14.1%), Bolivarian Republic of Venezuela (12.9%), Argentina (9.6%) and Peru (7.7%). The rest (20.5%) was distributed among 17 other countries. In turn, the origins of announcements in the same period were less concentrated than destinations, and were distributed mainly between the United States (20.5%), Spain (12.1%), Canada (8.1%), Brazil (6.7%), France (6.4%), the United Kingdom (6.0%), Italy (4.5%), Australia (4.0%), Bermuda (3.6%) and Germany (2.9%), and the rest (25.2%) among 36 other countries. It should be noted that, with the gradual decrease in the amount and number of investment announcements, the number of countries in the region receiving investments has also fallen. That is to say, announcements became more concentrated in fewer countries and countries' positions in investor preferences also shifted.[32]

This general trend, however, should not be allowed to obscure the fact that natural-resource-based sectors continue to attract significant FDI, especially in oil extraction. For example, ECLAC (2022a) notes that, in 4 of the 14 countries receiving FDI in the hydrocarbon industry (Brazil, Colombia, Guyana and Mexico) for which official statistics are available by sector, 10% of the FDI received in 2021 went to oil extraction.[33] Investment in this sector has gone mainly to conventional hydrocarbon deposits, as in the cases of the pre-salt deposits of Brazil and the fields of the Gulf of Mexico and, more recently, the new sites found in the deepwater basin of Guyana-Suriname. However, the energy transition potential of non-conventional hydrocarbons, particularly shale gas and tight gas, has also attracted investments, mainly in the pre-salt fields in Brazil and Vaca Muerta in Argentina.

State oil companies have historically played an important role in fossil fuel investments, especially upstream, having accounted for most of these investments in the hydrocarbon-producing countries of the region. Estimates by Altomonte and Sánchez (2016) and ECLAC (2013) on investment in hydrocarbon exploration, development and production reflect this for the period 2004–2014. In order to ascertain how the investments of these companies have evolved, an exercise was conducted to add the capital expenditures of seven of the main State oil companies in the region.[34] Their investments (without distinguishing by segment or business unit) peaked in 2013 at over US$ 100 billion, then fell by nearly 69% in 2017 —not including Petróleos de Venezuela, S.A. (PDVSA) in this change— to under US$ 25 million dollars since then (see figure VI.5). Furthermore, if these values are compared with those calculated by IEA on fossil fuel investments (with due caution regarding the interpretation of this

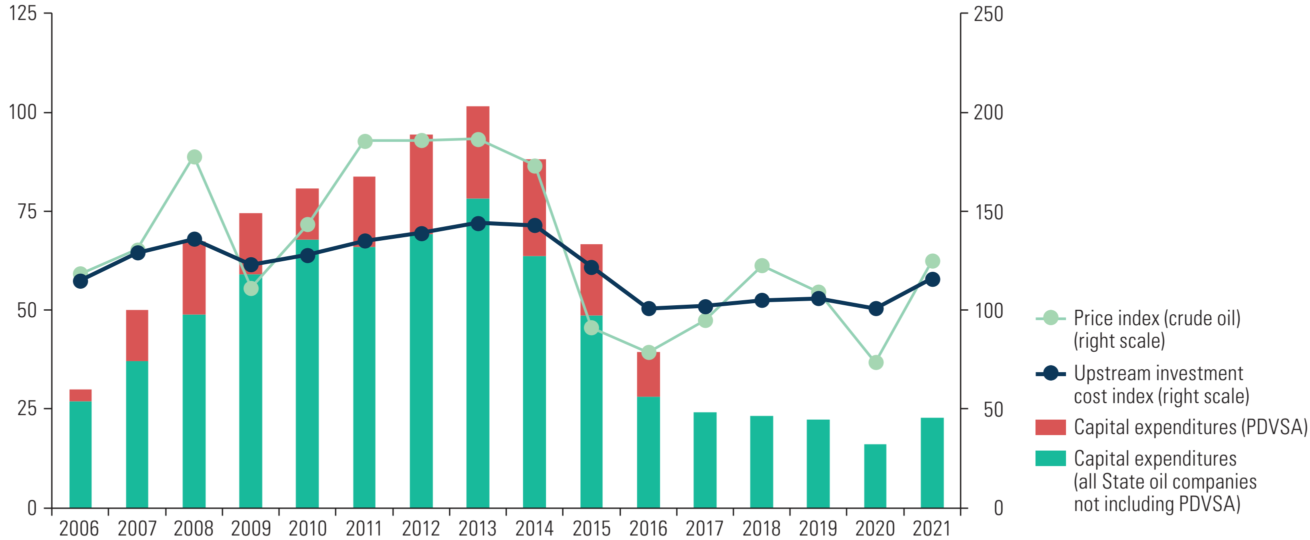
[32] According to the Financial Times, fDi Markets, in the period 2005–2009, the favourite destination country was the Bolivarian Republic of Venezuela, which captured 16.5% of the amounts announced; in 2010–2014, the frontrunner was Colombia, with 41.3%; in 2015–2019, Mexico, with 28%; in 2020, Brazil, with 50.4%; and, in 2021, Colombia again, with 37.8%.

[33] According to ECLAC (2022a), information on FDI inflows by sector in 2021 is available only for 14 countries, which account for 86% of total FDI inflows in the region in that year.

[34] The seven companies included were Yacimientos Petrolíferos Fiscales S. A. (YPF), of Argentina; Petróleo Brasileiro S. A. (Petrobras), of Brazil; Ecopetrol S. A., of Colombia; Petróleos Mexicanos (PEMEX), of Mexico; Staatsolie Maatschappij Suriname N.V. (Staatsolie), of Suriname; Petroleum Company of Trinidad and Tobago Limited (Petrotrin) and, since 2018–2019, Heritage Petroleum Company Limited, of Trinidad and Tobago, and Petróleos de Venezuela, S. A. (PDVSA), of the Bolivarian Republic of Venezuela (for which accounting data is available only up to 2016). The companies Yacimientos Petrolíferos Fiscales Bolivianos (YPFB), of the Plurinational State of Bolivia, and Empresa Pública de Hidrocarburos del Ecuador (Petroecuador), of Ecuador, were not included owing to the lack of accounts or official data (from audited financial statements). Petroperú S. A. and Perupetro S. A., both of Peru, were not included either, because their main activity is not exploration and exploitation of hydrocarbons and they do not make investments in this segment.

exercise, given the methodological and source differences), the investment share of these seven companies is seen to have fallen in recent years. Their average contribution is estimated to have dropped from 66% to 50% between the periods 2015–2017 and 2019–2021.[35]

Figure VI.5
Latin America and the Caribbean (7 countries): capital expenditures by State oil companies, crude oil price index and upstream investment cost index, 2006–2021
(Billions of current dollars and indexes: base year 2005=100)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, *World Bank Commodity Price Data (The Pink Sheet)*, several editions; International Energy Agency (IEA), *World Energy Investment 2020*, Paris, 2020 [online] https://www.iea.org/reports/world-energy-investment-2020/fuel-supply; IEA, *World Energy Investment 2022*, Paris, 2022 [online] https://www.iea.org/reports/world-energy-investment-2022; data from Bloomberg, and State oil companies' annual reports.

Note: Capital expenditures include total capital expenditures (without distinguishing by segment or business unit) in current dollars of the following State oil companies: YPF (Argentina), Petrobras (Brazil), Ecopetrol (Colombia), PEMEX (Mexico), Staatsolie (Suriname), Petrotrin and, from 2018–2019, Heritage Petroleum (Trinidad and Tobago), and PDVSA (until 2016) (Bolivarian Republic of Venezuela). The crude oil price index is based on the year 2005 and was calculated from the simple average of the nominal prices of Brent and West Texas Intermediate (WTI). The upstream investment cost index (UICI) is calculated by IEA.

It may be inferred, then, that State oil companies in general have not been able to increase the pace of investments to develop abundant hydrocarbon reserves. The investments made have not been enough to replace these reserves either, and private energy investors, both traditional and new, have been more inclined to invest in renewable energy than in large-scale development of fossil fuels. Thus, too little investment has been attracted to finance exploration and the region's oil and natural gas reserves have begun to decline in the past decade. Between 2000 and 2010, these reserves grew by 174.0% and 11.1%, respectively, then, after peaking in 2014 in the case of oil (335,327 million barrels, with the certification of reserves in the Orinoco belt) and in 2012 in the case of gas (8.611 bcm), between 2010 and 2020 they decreased by 0.3% and 4.5%, respectively. Globally, reserves of these fuels continued to grow, although at a slower rate than in the first decade of the millennium (BP, 2022). These variations include the Bolivarian Republic of Venezuela, however, and excluding this country, the net addition of reserves in the region is negative: oil reserves fell by more than 41% (18.176 billion barrels) and gas reserves by almost 40% (1.189 bcm) (see tables VI.2 and VI.4).

[35] For comparison purposes, PEMEX capital expenditures were included in the IEA calculations and post-2016 expenditures by PDVSA were estimated, and added to the total expenditure of the seven State oil companies.

The performance of the region's countries in these investments could be explained in part by the global trend of investments in fossil fuels in recent years, with the adverse relative position of oil prices with respect to unit capital expenditures for exploration and exploitation between 2015 and 2020, as observed in relation to crude oil price indices and the cost of upstream investment, as well as other factors, such as the energy insecurity and economic uncertainty mentioned earlier within a framework of global agendas. It should be added that the fossil fuel producing countries of the region also face structural challenges and other agendas with urgent priorities that condition or block their energy policy and the strategic role of their State oil companies in correcting energy investment gaps.[36]

State oil companies have historically contributed, alone or by contracting, to the development of hydrocarbon reserves (exploration) and production (exploitation). This remains the case today, despite government policies and regime reforms in some countries in the region that have given greater prominence to private investment (foreign or national) or that have used these companies to capture and redistribute the economic rents of the sector, by means of special taxes or direct transfers from State oil companies, but neglecting to support their investment. In several cases, this has resulted in a deterioration in performance (economic, financial or even equity), as well as the monetization of reserves in fields that began to decline amid rapid exploitation. Other countries, such as Brazil and Colombia, have generally boosted the strategic role of State oil companies in investment and production.

Likewise, Argentina, the Bolivarian Republic of Venezuela, Brazil and Mexico depend largely on the large-scale exploitation of non-conventional resources, although this term refers to very different resources and reserves in each of these countries. The role played by State oil companies in development has been crucial, although it has fallen short of its potential. The importance of the exploitation of non-conventional resources is evident both in the minimum hypothesis, to cover domestic demand and the need to substitute imports in the cases of Argentina, Brazil and Mexico, and in the maximum hypothesis, to increase exports and provide the foreign exchange that all hydrocarbon-producing countries require.

As an illustration of this role of State oil companies globally, based on data from the Natural Resource Governance Institute (NRGI) (2019), a sample of 36 of these companies in 30 countries was taken and it was calculated that they contributed over 45% of global oil and natural gas production in 2021 (measured in daily barrels of oil equivalent) and about 84% of the total hydrocarbon production of the sample countries.[37] In Latin America and the Caribbean, in a sample of 9 companies, State oil companies contributed just over 5% of global oil and natural gas production and represented almost 12% of the production of the sample of 36 State oil companies worldwide. Likewise, they contributed about 81% of the total production of the sample countries in the region and 77% of the region's total production (see figure VI.6).

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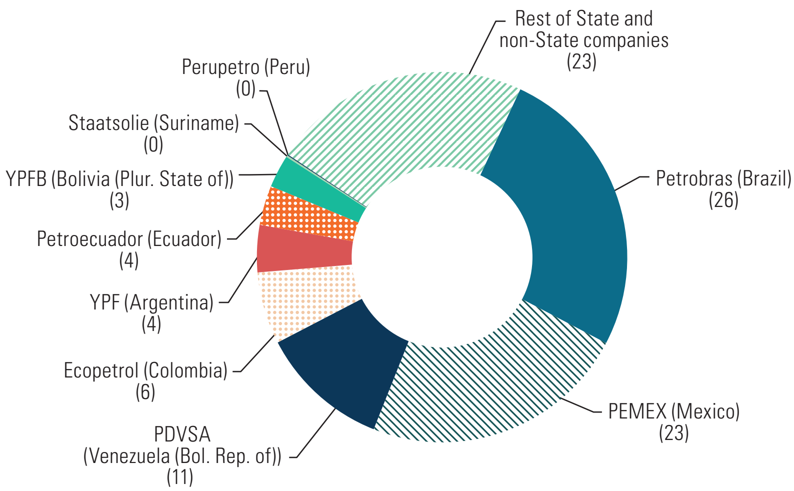
36 An example of this is fossil fuel subsidies (through discretionary consumer pricing), which have been perpetuated, with effects of differing intensity and magnitude, in most hydrocarbon-producing countries in the region since 2000. These subsidies cause distortions that have economy-wide (and sector-wide) effects, carry a fiscal cost, and can harm consumers rather than benefit them. The negative effects on the energy sector include the possibility of worsening its performance (due to supply failures) and an energy shortage (due to the adverse incentives caused by investment subsidies).

37 The 30 countries in the sample represented over 54% of global oil and natural gas production. The NRGI (2019) database includes 71 State-owned oil companies from 61 countries. The database does not have complete information on oil and natural gas production by each company and country, particularly for recent years. This reflects the need to increase the transparency of information on State-owned oil companies, on the part of both the companies and the States that own them.

Figure VI.6
Latin America and the Caribbean (9 countries): share of each State oil company in oil and natural gas production in the region, 2021
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Natural Resource Governance Institute (NRGI), *The National Oil Company Database*, 24 April 2019 [online] https://resourcegovernance.org/publications/national-oil-company-database / and BP, bp Statistical Review of World Energy 2022: 71st edition, 2022 [online] http://www.bp.com/statisticalreview.

Note: Percentages are calculated on the basis of total oil and natural gas production, measured in barrels of oil equivalent per day.

Finally, it should be noted that price cycles and volatility not only directly affect investment in exploration and exploitation and, therefore, the production of hydrocarbons, but also indirectly affect the activity of national or foreign locally operating suppliers of goods and services (common and specialized) in this industry. That is, the volatility of fossil fuel prices has direct and indirect effects on the hydrocarbon industry and induced effects on the economy (such as production and employment). Companies that provide goods and services to the industry play a key role in the fossil fuel supply chain. They not only support its operation, while generating economic activity through resource mobilization and the creation of value added and employment, but also embed technologies, develop capabilities and apply innovations that can be adopted in other industries, in both the domestic and the external market (see box VI.1). These supplier networks in fossil fuel producing countries can contribute to structural change in the countries, but this requires policies and programmes with a comprehensive and long-term vision of the industry (all along the chain) that views its development within the framework of market dynamics in the region and globally, and the opportunities and challenges presented by global agendas on sustainable development and climate change.

Box VI.1
Suppliers of goods and services to the natural gas and oil industry: the case of Argentina

The report by Neuman and others (2012), which is an executive summary of the strategic plan for the development of suppliers of goods and services of the gas and oil industry in Argentina, offers an interesting description and analysis of these companies' supply and demand, summarizes the international experience in terms of policies to develop suppliers of the oil and natural gas industry in Norway and Brazil, and puts forward policy recommendations to develop the national network of industry suppliers.

The report describes the general situation of the supplier network (of specialized services with high value added, goods and equipment and general services) and its importance for the oil and natural gas industry in the different segments —prospecting, exploration, production and decommissioning (upstream), crude oil and natural gas transportation and storage (midstream) and crude oil and natural gas refining or processing, distribution, sale and final use (downstream)—. It examines local supply and innovation capabilities in different areas, as well as the gaps and challenges in advancing in import substitution and technological development at the end of the first decade of the 2000s.

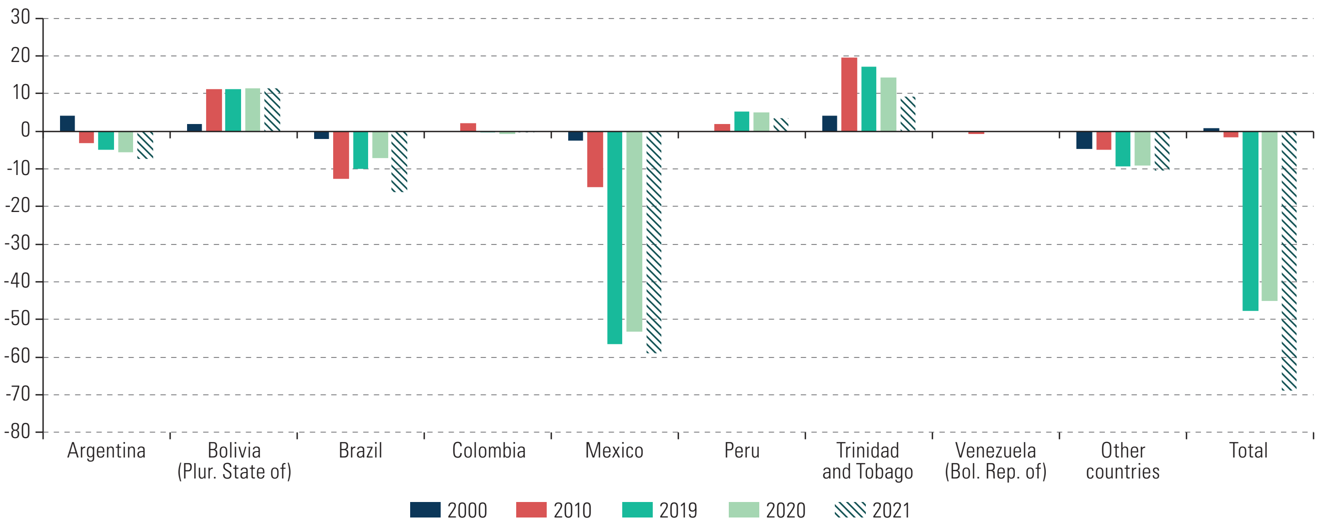
The report's policy recommendations for developing the national network remain valid. However, it may be necessary to adapt them to the current context of the global energy crisis and growing pressure from society to comply with global agendas on sustainable development and the fight against climate change. Accordingly, new questions arise: (i) what role should the national hydrocarbon industry and its suppliers play in the energy transition?; (ii) what energy mix is right for Argentina in 2050?; and (iii) how can the supplier network be supported to develop new capabilities and expand their client portfolio to other industries?

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of M. Neuman and others, "Plan Estratégico para el Desarrollo de Proveedores de Bienes y Servicios de la Industria del Gas y del Petróleo – Informe Final Consolidado 2012", Instituto de Industria (IDEI), National University of General Sarmiento, 2012, unpublished.

3. The weight of fossil energies in the region's international trade

Since the turn of the century, the hydrocarbon production-to-consumption ratio has deteriorated significantly. This is especially true in the case of natural gas, of which there has been a significant production shortfall since 2010 (reflecting Mexico's production, which first stagnated and then began to decline, while its consumption has been increasing such that it has become the main regional consumer). In the case of oil, the surplus —which exceeded 4 million barrels per day in the mid-2000s—is less than 1 million barrels per day at the present (due to the fall in oil production in the Bolivarian Republic of Venezuela, but also in Mexico). This is in addition to the fact that refining capacities are not fully adequate technologically speaking nor sufficient to meet the regional demand for derivative products (or refined products). Thus, most fossil fuel producing countries have declined in both self-sufficiency and levels of surplus for export (see figures VI.7 and VI.8).

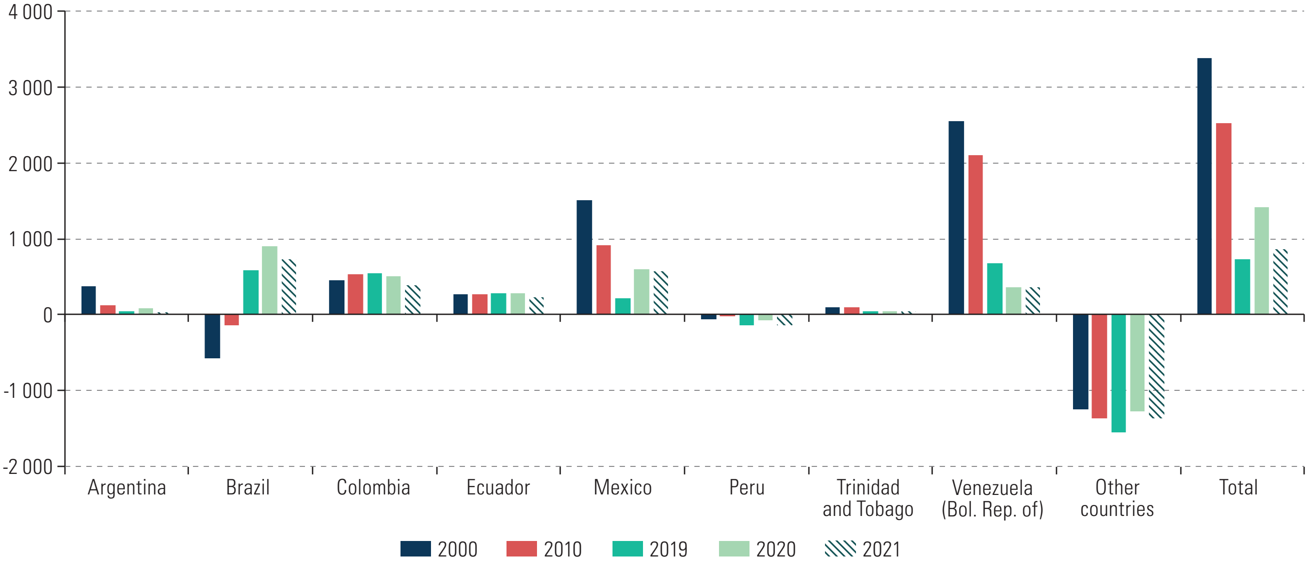
Figure VI.7
Latin America and the Caribbean:[a] natural gas surplus by country, 2000, 2010 and 2019–2021
(Billions of cubic metres)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, *bp Statistical Review of World Energy 2022: 71st edition*, 2022 [online] http://www.bp.com/statisticalreview.

[a] Latin America and the Caribbean includes the countries grouped in South America and Central America, according to the definition of BP (2022), plus Mexico.

Figure VI.8
Latin America and the Caribbean:[a] oil surplus by country, 2000, 2010 and 2019–2021
(Thousands of barrels per day)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of BP, *bp Statistical Review of World Energy 2022: 71st edition*, 2022 [online] http://www.bp.com/statisticalreview.

[a] Latin America and the Caribbean includes the countries grouped in South America and Central America, according to the definition of BP (2022), plus Mexico.

This marked deterioration in surpluses is a worrying trend for the region as a whole, which is reflected in the trade balances of both primary fossil fuels and their derivatives (or refined products). This, in turn, has an impact on the balance of payments, tightens the external constraint and increases the risk of energy dependence.

Exports of fossil fuels (both raw materials and derivatives) from Latin America and the Caribbean, in dollars, increased much less than imports of these goods in the period 2000–2021 (by a factor of 1.9 compared to 4.6). Thus, fossil fuel exports —which represented 15.4% of total goods exports between 2000 and 2002 and exceeded an average of 20% between 2005 and 2014, during the strongest price boom, peaking at 23.4% in 2008— declined to 10.0% in 2019–2021. In GDP terms, fossil fuel exports represented 2.5% of the region's economic activity in the period 2000–2002 and averaged almost 4% between 2005 and 2014, with a peak of 4.6% in 2008, but then fell to 2.0% in 2019–2021.

Meanwhile fuel imports went from 7.5% to 12.4% of total imports in current dollars between the periods 2000–2002 and 2019–2021, and registered an average of over 13% between 2005 and 2014, peaking at 15.6% in 2013. Likewise, with respect to GDP, fossil fuel imports increased from 1.3% to 2.5% between the first two periods, that is, they matched the percentage of fossil fuel exports at the beginning of the millennium.[38] On the other hand, the deterioration of the region's trade position combined with the decline of the basket of products traded by value added. Although the proportion of fossil fuel raw materials and derivatives exported remained the same throughout the period —in a range of 75% to 80% and 25% to 20%, respectively— the proportion of these goods imported decreased from 49% and 51%, respectively, to 33% and 67% (see table VI.7). Given the trend in international fossil fuel prices in 2022 and the need for countries in the region to import derivatives, it is unlikely that the direction of these variables will change in the short to medium term.

[38] Estimates by ECLAC on the basis of UN Comtrade Database and CEPALSTAT.

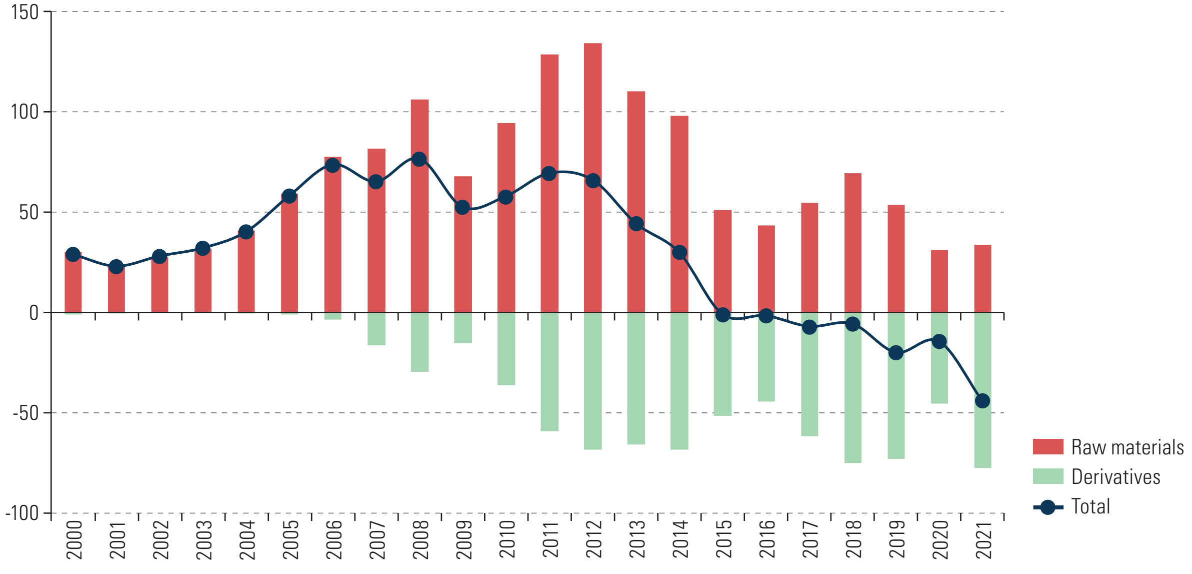
Table VI.7
Latin America and the Caribbean: exports and imports of fossil fuels, 2000–2002, 2010–2012 and 2019–2021
(Millions of current dollars and percentages)

	2000–2002	2010–2012	2019–2021
Exports	53 747	216 102	99 595
Percentage of total goods	15.4	21.3	10.0
Percentage of GDP	2.5	3.8	2.0
Percentage of raw materials	75.0	80.4	80.9
Percentage of derivatives (or refined products)	25.0	19.6	19.1
Imports	27 196	151 856	125 857
Percentage of total goods	7.5	14.6	12.4
Percentage of GDP	1.3	2.7	2.5
Percentage of raw materials	48.7	36.1	32.8
Percentage of derivatives (or refined products)	51.3	63.9	67.2

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/ and Chatham House, resourcetrade.earth, 2021 [online] https://resourcetrade.earth/.
Note: The calculation of the flows of exports and imports of fossil fuels includes the trade flows of raw materials and derivatives (or refined products) of oil, natural gas and coal in millions of current dollars and was prepared based on the Chatham House methodology (2021).

Regarding the composition of the total balance of fossil fuels, separation of raw materials and derivatives shows that, although the region's trade balance rose steadily, reached a peak in 2008 and remained above US$ 50 billion until 2012, thereafter it gradually fell until it turned negative in 2015. This fossil fuel trade deficit reflects not only falling production of crude oil, gas and coal (with the consequent decline in exportable balances), but also a considerable increase in imports of refined products (such as gasoline, fuel oil, diesel or gas oil) (see figure VI.9).

Figure VI.9
Latin America and the Caribbean: trade balances of fossil fuels, by raw materials and derivatives, 2000–2021
(Billions of dollars)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/ and Chatham House, resourcetrade.earth, 2021 [online] https://resourcetrade.earth/.
Note: The calculation of the flows of exports and imports of fossil fuels includes the trade flows of raw materials and derivatives (or refined products) of oil, natural gas and coal in millions of current dollars and was prepared based on the Chatham House methodology (2021).

The degree of productive specialization of the hydrocarbon-producing countries in the region shows that six of them depend to varying degrees on exports of these fuels, and are highly vulnerable to international price fluctuations. These countries historically run fossil fuel trade surpluses and are net exporters. This group comprises the Bolivarian Republic of Venezuela, Colombia, Ecuador, the Plurinational State of Bolivia, Trinidad and Tobago, and, currently, Guyana, given the recent developments in its hydrocarbon industry, which has led to unprecedented economic growth of the country and its exports.[39]

The degree of dependence of these countries may be measured by comparing the share of fossil fuel exports with total goods exports and with goods imports in order to determine the degree of coverage in the trade balance. For example, in the case of the Bolivarian Republic of Venezuela, in the period 2019–2021, the degree of dependence was 72.8% and the coverage level was 95.2%. That is, fuel exports alone are enough to cover almost all goods imports. These percentages were even higher a few years ago. In the other five countries, which are highly dependent on natural resource exports in general, but only partially on fuels, the ratios are as follows: 48.8% and 35.3% in Colombia, 47.5% % and 38.1% in Guyana, 41.8% and 51.7% in Trinidad and Tobago, 32.5% and 34.9% in Ecuador, and 27.1% and 27.7% in the Plurinational State of Bolivia. However, the trade surplus in fossil fuels has fallen in relation to GDP in this group of economies, from almost 12% in 2000–2002 to around 14% between 2010 and 2012 and, subsequently, to 5% in 2019–2021. This reflected price developments and the decrease in exports of crude oil and refined products as well as rising imports of refined products and the lower productive performance of several of the fossil fuel producing countries (see figure VI.10).

This vulnerability arises from the fact that none of the region's producing countries are price-setters, since this depends on the geopolitical balances of the great powers and international organizations such as OPEC, as well as other large producers such as the Russian Federation, which is part of OPEC+, or the United States. Geopolitical rivalry for access to and control of oil supplies arise because endowments of hydrocarbon energy resources are the result of geography and are unequally distributed between different countries. These structural imbalances in endowments (and, therefore, production and consumption) are fundamental to understanding the geopolitics of energy, which draws on the dynamics of energy trade, trends in energy markets and the potential of these markets to be controlled and managed (for example, for the supply security of importers or the demand security of suppliers).[40]

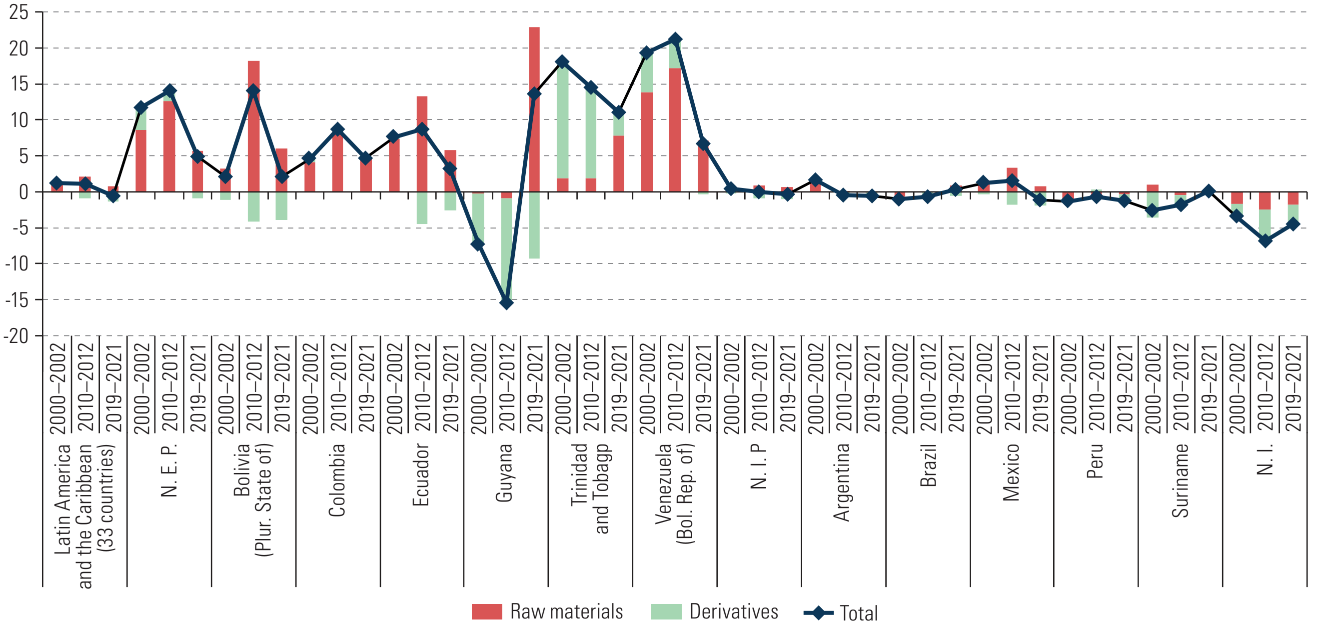
Net-importing producer countries and net-importing non-producer countries are not immune to the vulnerability arising from price cycles and volatility. Although they are not dependent on fossil fuel exports, they must import these energy resources to run their economies. The net importing producer economies today are Argentina, Brazil, Mexico, Peru and Suriname. They all maintain a small deficit or a surplus in the fossil fuel trade balance, as the case may be. Thie group's balance of trade has also deteriorated in GDP terms, but more slightly and with less fluctuation than in the case of net exporters. On average, it went from equilibrium in the period 2000–2002 to a deficit of less than 1% in 2019–2021. The rest of the economies in the region, some with limited extraction and refining capacities, such as Chile, are net importers and present substantial trade deficits. Furthermore, these economies' fossil fuel trade deficit

39 Between 2019 and 2021, Guyana's GDP at current prices increased by over 31.7% and goods exports by over 186% (data from UN Comtrade Database and CEPALSTAT).

40 Geopolitical analysis also involves consideration of energy transit routes, the risks associated with certain routes, and conflicts over access and security issues (Stevens, 2019). Furthermore, the global supply of oil is oligopolistic, since its production and trade are concentrated in a few stakeholders. For example, in 2021, just over 91% of crude oil production was accounted for by OPEC+ (67.1%), the United States (18.5%) and Canada (6.0%).

has worsened in relation to GDP, compared to the start of the millennium, going from an average of just over 3% in 2000–2002 to over 4% in 2019–2021 (see figure VI.10). Again, underlying this deterioration in the trade balance is the growth in imports of refined products.

Figure VI.10
Latin America and the Caribbean: trade balances of fossil fuels, by raw materials and derivatives, 2000–2021
(Percentages of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database [online] https://comtradeplus.un.org/; ECLAC, CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en and Chatham House, resourcetrade.earth, 2021 [online] https://resourcetrade.earth.

Note: The calculation of the flows of exports and imports of fossil fuels includes the trade flows of raw materials and derivatives (or refined products) of oil, natural gas and coal in millions of current dollars and was prepared based on the Chatham House methodology (2021). The calculation of trade balance flows for countries and groups of countries is a weighted average. N.E.P.: group of net exporting producer countries (6 countries); N. I. P.: group of net importing producer countries (5 countries); N.I.: group of non-producer, net importing countries (22 countries).

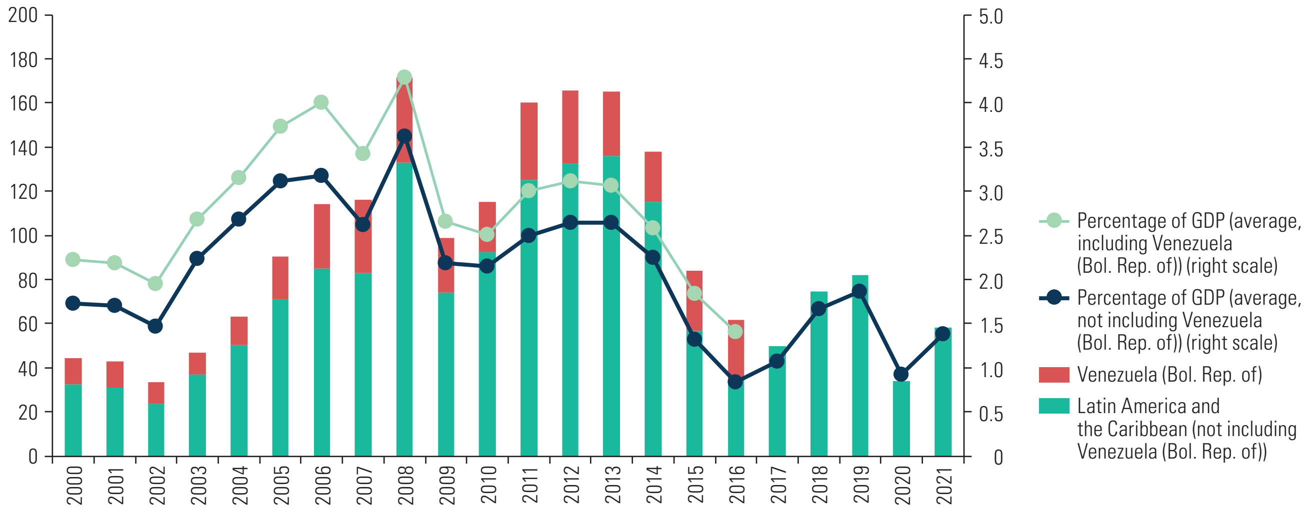
4. Fiscal revenue from the exploitation of hydrocarbons

As noted earlier, the countries of the region present different degrees of vulnerability to the cycles and volatility of international fossil fuel prices. Rising prices benefit net-exporting producer economies and create incentives to develop the industry. On the other hand, they can have disparate effects on net-importing producers, depending on the situation and the share of fossil fuels in their trade balance, in domestic consumption, in tax revenues and in subsidies, among others. For non-producer net-importing economies, higher prices have adverse effects. Falling prices have opposite effects in these three groups of economies.

Vulnerability to international prices is also evident in fiscal revenues derived from hydrocarbon extraction, especially in net-exporting producer economies, where these can contribute substantially to total government revenues. In a sample of 11 countries in the region that produce oil and natural gas, the sum of revenues was US$ 40.2 billion on average per year between 2000 and 2002, which represented 2.1% of the GDP of this group of countries. From 2010 to 2012, during some years of the commodity boom, the sum of revenue increased significantly, exceeding US$ 147.1 billion on average per year, or 2.9% of the group's GDP. At the end of the period analysed, between 2019 and 2021, the sum of revenue contracted to a yearly average of US$ 58.1 billion, equivalent to 1.4% of the group's GDP (since 2020 this includes Guyana, but not the Bolivarian Republic of Venezuela, for which revenue data have not been available since 2017).

If only net-exporting economies are considered from this group, the average share in GDP doubles, which highlights the weight of tax revenue from this activity in these economies: the GDP share averaged 5.9% between 2000 and 2002, 7.5% between 2010 and 2012 and 3.3% between 2019 and 2021 (see figure VI.11). In particular, these revenues have been very significant throughout the period analysed in the cases of the Plurinational State of Bolivia, Ecuador, Trinidad and Tobago and Bolivarian Republic of Venezuela, but also Mexico, which became be a net importer of fossil fuels after the first decade of the millennium. For example, fiscal revenues from hydrocarbons represented on average 9.4% of GDP and 28.4% of total tax revenues in the Plurinational State of Bolivia in the period 2010–2012, and 3.7% and 14.6% , respectively, between 2019 and 2021; or 14.1% of GDP and 37.3% of Ecuador's total tax revenue from 2010 to 2012, and 7.8% and 22.4% from 2019 to 2021; or 13.1% of GDP and 43.3% of the total tax revenues of Trinidad and Tobago between 2010 and 2012, and 5.2% and 20.6% between 2019 and 2021. In Mexico, these revenues have less weight in the economy, which is the region's most diversified. However, given that the State company PEMEX, the country's main oil and gas company, makes payments to the government through non-tax instruments (in particular, shared utility and extraction rights), these revenues represented 35.3% of total tax revenues in the period 2010–2012 and 8.2% in the period 2019–2021. This was despite the production and financial difficulties experienced by PEMEX, which led the government to reduce the rate of the shared utility right from 2019 onward.

Figure VI.11
Latin America and the Caribbean (11 countries):[a] fiscal revenues from hydrocarbon extraction, 2000–2021
(Billions of dollars and percentages of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=en.

[a] Weighted average for the following countries: Argentina, Bolivarian Republic of Venezuela (until 2016), Brazil, Colombia, Ecuador, Guatemala, Guyana (since 2020), Mexico, Peru, Plurinational State of Bolivia, and Trinidad and Tobago.

The collection of revenues from hydrocarbons activity in the region is explained mainly by non-tax or special instruments that are applied both to exploration and extraction. Among these are royalties and taxes on windfall profits —similar to taxes on the economic rents of natural resources intended to tax extraordinary earnings— among many others (on bases and premises that may differ, such as bonuses, production sharing, rights, tariffs, rates or dividends). Among tax instruments that form part of the general regime, which is to say those that also apply to other activities or sectors of the economy, profit taxes are notable for their contribution to overall collection, although in some countries a surcharge or different rate is applied to hydrocarbon exploration or exploitation, as in Trinidad and Tobago. In this regard, some non-tax instruments, such as royalties, are generally deducted from the tax base of the profit tax. Both State oil companies and other firms in the sector are subject to both types of instruments, according to the fiscal regime and the applicable exploration and exploitation modality.[41] However, according to ECLAC (2022b), State oil companies receive special treatment in some countries. In addition, as most national oil production comes from existing fields operated by national oil companies or their partners, these are governed by the fiscal conditions prevailing at the start of operations, which may differ substantially from the current fiscal framework, especially where there are special tax invariance regimes.

In the sample of 11 countries in the region, non-tax instruments accounted on average for 85% of the fiscal revenues from hydrocarbons activity in 2000–2002, 89% in 2010–2012 and 92% in 2019–2021. The high share of non-tax instruments compared to tax instruments in the collection of the sector shows how important they are in capturing the economic income generated by the activity. These percentages represent averages for the regional bloc overall, however, and although non-tax instruments account for a larger share in revenue in most of the countries in the sample this is not true for all of them. For example, in Trinidad and Tobago firms in the hydrocarbons sector are subject to a special rate of profit tax higher than for other sectors.

As described by ECLAC (2022b), the tax regimes applied to the extractive industry can be evaluated and compared in terms of desirable attributes and the performance and outcomes of each of these in the different regimes can be enhanced by various instruments. The best instrument from the economic efficiency standpoint is the natural resource rent tax.[42] However, a fiscal regime based exclusively on this instrument would have the disadvantages of postponing the moment when a project starts to generate income for the State, or that no income is received in the years when the price is not high enough to cover the opportunity cost of capital. That is why, in developing countries, the evidence points to a combination of several instruments, for example an ad valorem royalty at a moderate rate that guarantees revenue from the start of operations; an income tax that guarantees revenue even when the return obtained by the operator does not exceed the normal return; and a profit-based royalty or a natural resource rent tax that makes it possible to capture a larger share of the economic rents of the extractive industry. In this respect, all the countries in the region apply profit-based taxes (although some with surcharges or higher rates for hydrocarbon exploration or exploitation). Most also apply ad valorem royalties (some at fixed rates and others at progressive rates), some tax windfall profits and most complement these with other

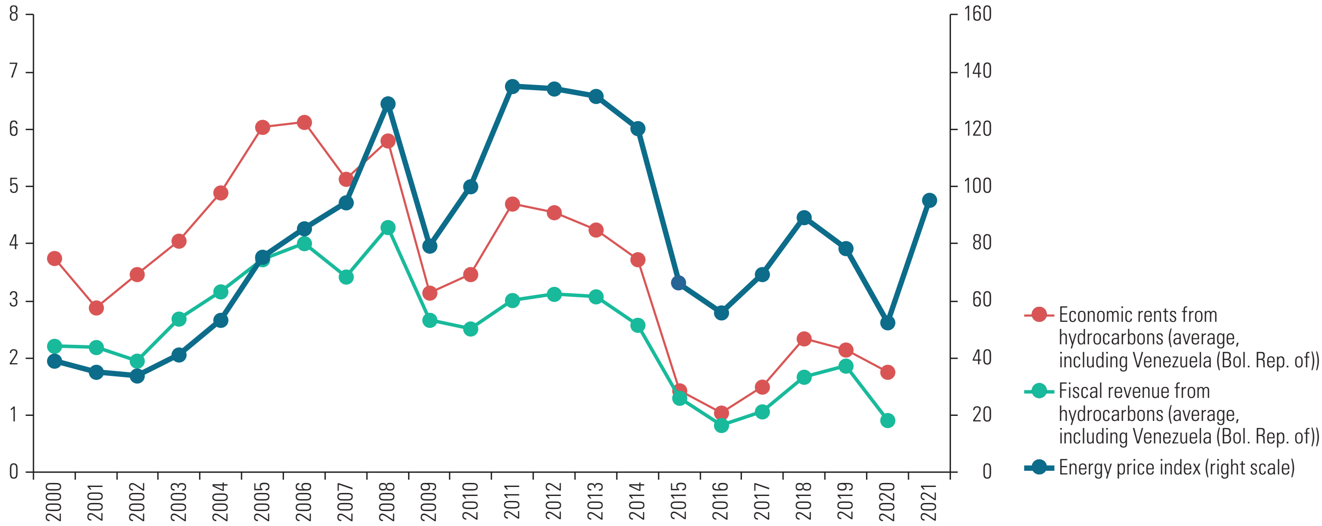
[41] Nakhle (2010, cited in ECLAC, 2022b) recalls that States have basically three strategies available: (i) carrying out the activities independently, through a State-owned enterprise that explores, produces and markets the resources; (ii) total delegation of the activities in question to private firms; or (iii) or a combination of the two. Private-sector participation in the exploration and production of non-renewable resources is normally subject to two types of regulatory framework or fiscal regime: concession systems and contract systems (services contracts or production sharing agreements, among others) (Gómez Sabaini, Jiménez and Morán, 2015, cited in ECLAC, 2022b).

[42] Taxes on economic rent only tax windfall profits (in excess of a project's normal returns), so, in theory, they should not affect exploration, development and mining decisions, even if applied at a 100% rate (without considering competition between tax regimes). Specific and ad valorem royalties are the least efficient economically, because they are equivalent to an additional production cost that must be paid even if the firms make a loss. This generates distortions, by reducing the return on the project relative to the no-royalty alternative —so some less profitable projects would not be carried out— or by affecting the amount of resources worth extracting. Profit-based royalties and income taxes are in an intermediate position, whereby payment varies in proportion to the project's profitability (ECLAC, 2022b).

instruments to capture a share in operating profits (bonuses) and in production, and for land use and other rights. None, however, make use of royalties on earnings or taxes on economic rents from natural resources.

The fiscal regimes applicable to hydrocarbon activity in the 11 countries in the sample, with their successes, weaknesses and room for improvement, on average capture a good part of the economic rents from hydrocarbons. A proxy for the capture of economic rents by governments (the government take) is obtained by comparing the fiscal revenues from extractive activity with the economic rents from hydrocarbons (oil and natural gas) in relation to GDP. The simple average of that proportion in the sample group was 64% between 2000 and 2002. It then rose to 68% between 2010 and 2012 and to 70% between 2018 and 2020 (although in 2020 that proportion was noticeably lower than in previous years) (see figure VI.12). ECLAC (2022b) conducted a different exercise to evaluate the government take (the effective tax rate), by modelling a shallow-water offshore oil extraction project, which is applied, on the same assumptions, to the tax regimes of six countries in the region. At prices of US$ 60 per barrel of crude oil and US$ 3 per million Btu of natural gas, the proportion was lowest in the Dominican Republic (41.9%), followed by Brazil, Colombia and Ecuador (61.8%, 64.4% and 66.3%, respectively). Higher takes were obtained by Mexico, with 87.9%, and Trinidad and Tobago, with 103.1%.[43] All this confirms previous observations regarding the capture capacity of fiscal regimes for extractive activities, insofar as they enable governments to capture a good part of the economic rents from hydrocarbons, although not all of them are progressive (in the sense that the government's share should at least hold steady when prices increase). A sensitivity analysis starting from a per barrel price of US$ 50 (up to US$ 120), found the government take to be regressive in Brazil, Ecuador and Trinidad and Tobago, progressive in Colombia and Mexico, and practically proportionate in the Dominican Republic.

Figure VI.12
Latin America and the Caribbean (11 countries):[a] fiscal revenues from hydrocarbon extraction with respect to hydrocarbon rents and energy prices, 2000–2021
(Percentages of GDP and index: base year 2010=100)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis CEPALSTAT [online] https://statistics.cepal.org/portal/cepalstat/index.html?lang=es and World Bank, "Oil rents (% of GDP)" [online] https://data.worldbank.org/indicator/NY.GDP.PETR.RT.ZS and "Natural gas rents (% of GDP) [online] https://data.worldbank.org/indicator/NY.GDP.NGAS.RT.ZS.

[a] Weighted average for the following countries: Argentina, Bolivarian Republic of Venezuela (until 2014), Brazil, Colombia, Ecuador, Guatemala, Guyana (since 2020), Mexico, Peru, Plurinational State of Bolivia, and Trinidad and Tobago.

[43] In this last case, the State appropriates more resources from the project than the economic rent that it generates.

The foregoing shows that, although there are various good practices in the region, there is also room for improvement with regard to fiscal regimes for hydrocarbon extraction.[44] Progressivity and tax administration in particular stand to be improved, in order to increase collection without reducing efficiency, especially taking into account global agendas and geopolitical issues in the global hydrocarbon market, which fuel uncertainty among investors and fossil fuel price volatility. This opens up an opportunity to improve the capture of economic rents (with more progressive and efficient instruments) and promote investment in productive and energy diversification (through public spending and tax incentives). Public administrations, tax and customs services alike, must also strengthen their capacities to properly control and oversee trade transactions involving the collection of fiscal revenues from extractive activities, in order to tackle abusive use of avoidance strategies, such as transfer pricing, undercapitalization and inter-company payments (ECLAC, 2022b; Gómez Sabaini and Morán, 2020).

The fiscal revenues derived from hydrocarbons are a function of the economic rents from oil and natural gas and the fiscal regimes established for the extractive activity. In other words, they depend, on the one hand, on commodity prices, capital expenditures and operating costs and, on the other hand, on the capacities of public administrations and the fiscal (tax and non-tax) instruments put in place by governments to capture economic rents.[45] If a project is not profitable, it will not come on stream and will not generate income. Nor will it generate rents if a project already in operation has total average expenditures per unit of product in excess of its sales price. Governments therefore face the challenge —and also the opportunity— of designing a fiscal regime to strike a balance between maximizing the capture of economic rents from extractive activities and minimizing the disincentives for economic agents to invest in hydrocarbon exploration and exploitation.

There are other internal factors originating in fiscal policies that are influenced by this equation and interact with it, that is, with the performance of the fiscal regime, and which can shape trends in the sector. Two of these are: (i) sovereign funds; and (ii) fossil fuel subsidies. Some countries in the region, such as the Bolivarian Republic of Venezuela, Chile, Colombia, Guyana, Mexico, Panama, Peru, the Plurinational State of Bolivia, Suriname, and Trinidad and Tobago have created sovereign funds and, with the exception of Panama, all have significant fossil fuels or minerals extractive activity.[46] These are formed from different sources of government revenue (tax and non-tax instruments, asset management, decrees and laws on budget allocation or surpluses, among others), but they clearly draw directly or indirectly on extractive activities and the capture of the economic rents they generate. Given that these funds have essentially been geared towards savings and stabilization, the asset classes of choice, albeit with different investment criteria, have been high-liquidity, low-risk financial assets. The region yields no obvious cases of high impact instruments with other purposes, such as economic development (for example, investment in economic infrastructure or technological and productive capacities) or the development of an emerging industry, where investment in real assets is usually greater than in financial

[44] For example, ECLAC (2022b) demonstrates in the offshore oil extraction project model that specific and ad valorem royalties are fundamentally regressive, since the greater the economic rent obtained, the lower the proportion paid to the State.

[45] A normal or competitive rate of return on sunk capital must also be considered within capital expenditures.

[46] The sovereign funds in all these countries are active today, except for the Bolivarian Republic of Venezuela, which is to say the Fund for Macroeconomic Stabilization (FEM).

assets and has greater effects on the national economy[47] [48]. These funds have thus fulfilled their purpose of contributing to economic stabilization in several countries by providing resources to weather the recent cascading crises (arising from the pandemic and the war in Ukraine, which have influenced commodity prices). However, due to their original composition and purposes, they have not supported the development of capacities for productive diversification or the creation of other forms of capital to replace capital depleted by the exploitation of non-renewable natural resources. This gap must be addressed by countries that are rich in these resources.

Fossil fuel subsidies, which vary depending on the fuel, the type of subsidy and the way it is measured, are found in all the countries in the region, but they are generally more significant in terms of GDP, fiscal cost and duration over time in the net-exporting producer countries.[49] According to an estimate by Altomonte (2023), which applies the price gap methodology to a sample of 11 countries, the weighted average of the fossil fuel subsidy (premium gasoline, regular gasoline and diesel) in the group of net exporters excluding the Bolivarian Republic of Venezuela was 0.8% of GDP in the period 2010–2012 and, more recently, 0.5% of GDP in 2020–2022. Including the Bolivarian Republic of Venezuela, these averages were 2.7% and 1.6% in the two periods, respectively. These countries, in general, set prices below the market price and maintain a very low or even negative pass-through effect, so consumption subsidies are important and widespread and price containment measures are not temporary.[50] In the group of net-importing producers, the weighted average of subsidies relative to GDP was lower throughout the period: 0.5% of GDP from 2010 to 2012 and 0.1% of GDP from 2020 to 2022. Between 2016 and 2021, revenues, albeit marginal, were even obtained from the collection of taxes included in the final consumer prices of gasoline and diesel. These countries generally set prices above the reference price and regulate pass-through but in a positive direction and at a higher rate than the first group, make use of temporary containment measures (although some tend to extend them longer than initially agreed) and have stabilization mechanisms to cushion pass-through.[51]

47 Only the sovereign fund of the Plurinational State of Bolivia —Fund for the Productive Industrial Revolution (FINPRO)—, created by law in 2012 (Law No. 232), has the sole purpose of financing the investment of productive enterprises of the State that generate surpluses, which is to say productive enterprises of the State or shared with the State to transform the productive matrix and necessarily including the stage of industrialization of raw materials. This is public financing for public investment that must be repaid. See Law no. 232 [online] https://www.bcb.gob.bo/webdocs/17_leyes/Ley232.pdf.

48 The debate over consuming, saving or investing the resources mobilized by the exploitation of non-renewable natural resources is not new. It covers broad themes that bring together sets of challenges, with common or interrelated explanatory factors, such as the resource curse, Dutch diseases or dependence on natural resources, among others. Barma and others (2012) analyse these issues in detail from a theoretical point of view and, based on case studies in different parts of the world, also consider empirical data to conclude that mitigating these situations is inherently a governance challenge. They add that resource-dependent countries face the fundamental challenge of how to reinvest part of the rents they receive from extractive industries in productive assets to replace the depleted non-renewable natural capital, while at the same time smoothing spending across price cycles and minimizing the negative effects of resource revenues on other sectors.

49 For example, subsidies may apply to all fuels or only some; to the demand side (consumer) or the supply side (producer); through different mechanisms (direct transfers from governments; government-induced transfers between producers and consumers, including price controls; tax credits or exemptions and other forgone revenues, or risk transfers to governments), and be generalized or targeted (on all or some households or individuals or segments of the supply chain). In turn, the calculation of a subsidy may vary depending on the methodology used (the price gap or the inventory gap), and whether it includes estimates of social and environmental externalities. See more information in Altomonte (2023) and UNEP (2019).

50 The group of net-exporting producers comprises the Bolivarian Republic of Venezuela, Colombia, Ecuador and the Plurinational State of Bolivia. Of the four countries, Colombia applied the lowest fuel subsidies in the period 2002–2022, with a total that was marginal in terms of GDP, less than 0.1%, and even obtained rents in several years. Furthermore, unlike the other three countries, Colombia has made efforts to make fuel prices more flexible since before the start of the millennium, and has a price stabilization mechanism in the form of the Fuel Price Stabilization Fund created in 2007.

51 The group of net-importing producers includes Argentina, Brazil, Mexico and Peru. Mexico began making gasoline and diesel prices more flexible in 2017, so that prices are determined based on market conditions, but fiscal stimuli have continued to be applied through the special tax on production and services (IEPS) in order to contribute to this process and cushion increases in international prices. Mexico obtained rents in the period analysed, except in 2005 and 2022, when total fuel subsidies were marginal in terms of GDP, at less than 0.01%. Peru established import parity prices as its market prices before the start of the millennium. However, faced with various problems in the markets for gasoline, diesel and other fuels, the government was forced to intervene with a number of measures and in 2004 created the Fund for the Stabilization of Prices of Fuels Derived from Petroleum (FEPC). Peru obtained revenues in the period analysed, except between 2006 and 2008, and then in 2010 and 2011, when total fuel subsidies came to less than 0.5% of GDP.

Finally, in the group of net-importing non-producers, in the weighted average, subsidies occurred in only a few years: in 2004 and 2005 and, later in 2021 and 2022. This yielded rents of 0.3 % of GDP in the period 2010–2012 and then subsidies of less than 0.01 % of GDP in 2020–2022. These countries, in general, like the second group, set prices above the reference price and regulate pass-through in a positive direction but at an even higher rate, so that market prices track international prices and capture rents (through the taxes included in final prices) or minimize subsidies. In these countries, prices are generally liberalized or governed by the import parity price through different mechanisms. However, temporary containment measures are also applied in certain situations, such as domestic or external crises that affect fuel prices or have a general inflationary impact.[52]

Goal 12 of the 2030 Agenda for Sustainable Development, on ensuring sustainable consumption and production patterns, includes target 12.c on the need to "rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities".[53] Rationalization of subsidies is justified not only because of the fiscal costs, but also because of the following: (i) market distortions that generate disincentives to investment in low-carbon fuels and energies; (ii) the risks of stranded assets; (iii) inefficient consumer behaviour; and (iv) the fact that generalized subsidies do not take into account the needs of households or sectors, among other reasons.[54] There are examples within the region and beyond of good practices (regulations, mechanisms and incentives) to eliminate inefficient subsidies and focus protection on the households that need it most via direct transfers. In some cases, revenues from specific consumption taxes are also used to develop capacities for productive diversification or create other forms of capital that support, for example, the development of the low-carbon fuel and energy industries.

C. Towards a new governance of fossil energies?

1. New strategies to drive progress towards the just energy transition and the 2030 Agenda for Sustainable Development and to combat climate change

The countries of the region, especially the hydrocarbon producers, must face the challenge of increasing investments in energy to achieve an adequate level of energy security and sovereignty and make firm progress in the energy transition, with a view

52 The group of net-importing non-producers comprises Chile, Paraguay and Uruguay. It should be noted that Chile, where the import parity price governs, has established different mechanisms since the 1990s to cushion international price rises: (i) the Petroleum Prices Stabilization Fund (FEPP) created in 1991; (ii) the Petroleum Fuel Price Stabilization Fund (FEPCO), in 2005; (iii) the Taxpayer Protection System for the Specific Tax on Fuels (SIPCO), in 2011; and (iv) the Fuel Price Stabilization Mechanism (MEPCO), in 2014. Today, FEPP applies only to kerosene and MEPCO applies to automotive gasoline, diesel, compressed natural gas and liquefied petroleum gas. Chile obtained rents in the period analysed, except in 2004, 2005 and 2007 and then in 2021 and 2022, when total fuel subsidies in terms of GDP were less than 0.15% of GDP. In Paraguay, fuel prices are liberalized, that is, they are set by the market for each fuel, with the exception of diesel, whose price is set by the government. Paraguay applied subsidies between 2004 and 2008, and then between 2018 and 2022, but the total subsidies in GDP terms reached their highest range, from 0.50% to 0.75%, first in 2004 and 2005 and then in 2021 and 2022. In Uruguay, prices are set by the government according to the import parity price at a single rate nationwide for each fuel. The domestic excise tax, which is applied to gasoline and diesel, has been used to cushion increases in international prices in certain situations. Uruguay has obtained income throughout the period analysed, with an average of 0.7% of GDP, with the exception of 2022, when it applied total of subsidies of less than 0.1% of GDP.

53 See [online] https://agenda2030lac.org/en/sdg/12-responsible-consumption-and-production/targets/12c.

54 See more information in UNEP (2019).

to meeting the objectives of global agendas while reducing their dependence on fossil energies (in economic activity, government revenue and expenditures, trade-related foreign-exchange inflows and outflows, and foreign investment). This will require them to close various gaps and overcome the challenges related to hydrocarbons governance, which became evident in the last price cycle, in order to transform the sector into a low-carbon energy sector able to contribute to a just energy transition.

The just energy transition must be sustainable and inclusive and must be adapted to the needs and capacities of the countries such that the transition's benefits and costs are distributed in accordance with the principle of equity —horizontal, vertical and intertemporal— between households and economic sectors, so that none are left behind. The process must leave none of them worse off within the framework of a short, medium and long-term vision.[55] For example, at the territorial level in countries with oil and gas reserves, the just dimension of the energy transition is an unavoidable imperative, since communities have activities and companies that rely on the exploitation of these resources. The transition will have to be carried forward in a simultaneous and comprehensive manner, alongside diversification, in order to protect the jobs, income and businesses of individuals in these territories and their energy supply. In other words, the energy transition, which implies the diversification of energy sources, must also contribute to productive diversification, not only at the national level, but also at the subnational level, so that local communities are transformed and benefit from the process.

The process of transforming the fossil energy sector must involve progressive distancing from systems based on fossil sources, moving towards others based on low-carbon sources. The fundamental aim must be to improve access to these sources, such as renewable and clean energies, and their coverage. This requires planning a gradual fossil energy exit strategy, which may differ depending on the specific needs, capacities and contexts of each country in the region, especially whether it is a hydrocarbon-producing country and how developed its oil and natural gas industry is. Furthermore, on the one hand, fossil fuels fulfil functions that renewable and clean energies cannot currently assume through electricity generation, such as industrial applications for the production of steel, cement or chemical products, among others. On the other hand, countries with untapped oil and gas resources that need to develop economically would be unable to use these resources, even though many of the developed countries in the world have done so. More sustainable use of fossil fuels thus constitutes a necessary complement to the other options to achieve a just energy transition. The penetration of renewable and clean energies and the improvement of energy efficiency are not the only factors that can contribute to global agendas.

Consequently, the transformation, as well as gradual, must be pragmatic, so that the region's developing countries can assume feasible commitments to develop sustainably and contribute to the fight against climate change. These commitments must be established based on their needs and capabilities and within the framework of the principle of common but differentiated responsibilities.

This transformation proposal, based on improvements in hydrocarbon governance, must be part of a comprehensive energy policy.[56] The policy guidelines focused on fossil energies include those described below.

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55 The International Labour Organization (ILO, n.d.) explains that "A Just Transition means greening the economy in a way that is as fair and inclusive as possible to everyone concerned, creating decent work opportunities and leaving no one behind. A Just Transition involves maximizing the social and economic opportunities of climate action, while minimizing and carefully managing any challenges – including through effective social dialogue among all groups impacted, and respect for fundamental labour principles and rights".

56 Energy policy must be comprehensive and cover all energy sources (primary and secondary) in the planning of generation scenarios for the fair energy transition. It must also be coordinated with other policies, in particular, with infrastructure, productive development and social development.

(i) Transform State oil companies into State energy companies. The aim is to diversify the asset portfolio with short-, medium- and long-term investment horizons to reduce risks (such as stranded assets) and acquire new capabilities in fossil energies to use them more sustainably. These capabilities include carbon capture, utilization and storage (CCUS) or the management of methane emissions along the entire chain, and capacities in low-carbon energies, such as renewable and clean energies.[57] [58] This requires not only investments, but also new partnerships (with key stakeholders) to acquire capabilities, which includes having the appropriate technologies and building the necessary infrastructure to develop these energies. Companies must also optimize the capture of economic rents, maximize operational efficiency, promote technological innovation and ensure good (environmental, social and corporate) governance. Several of the world's leading hydrocarbon companies are making different commitments regarding global agendas and scope 1, 2 and 3 emissions.[59] Accordingly, they are diversifying their asset portfolio, including in electricity generation and distribution from renewable sources, the production and transportation of hydrogen, the production of biomethane and advanced biofuels,[60] charging infrastructure and services for electric vehicles and storage, services for efficiency and technological solutions for decarbonization (such as CCUS, among others).[61] An example of a State-owned oil company that has transformed into a State energy company is Danish Oil and Natural Gas (DONG Energy), whose main shareholder is the State of Denmark. DONG Energy launched a strategic transformation process in 2009 to move from fossil energies to renewable energies. In the process, after overcoming several challenges, in 2019 it achieved the goal that had been set for 2040 of generating 85% of electricity and heat from renewable sources. In 2020, electricity and heat generation from renewable sources (especially wind) reached 90% and scope 1 and 2 carbon emissions were 86% lower than in 2007. The company divested from fossil fuels and invested in renewable energies at a gradual but firm and growing pace. In 2017 the company changed its name to Ørsted and is currently the world leader in offshore wind energy.[62]

(ii) Promote investments in energy, in order to close the gaps that condition energy security and sovereignty and guarantee access and coverage for homes and companies. Incentives are necessary to promote investments by the private

57 Carbon capture, utilization and storage (CCUS) technology can be installed in existing power plants and industrial plants, keeping them running. This addresses emissions in sectors where they are difficult to reduce, especially in industries such as cement, steel or chemical products. It also facilitates the production of low-cost, low-carbon hydrogen, which can contribute to the decarbonization of other parts of the energy system, such as general industry and freight transport by trucks and ships (see more information in IEA (n.d.-a)). Meanwhile, oil, gas and coal extraction operations release large amounts of methane, whether by accident or design. The energy sector is one of the main sources of emissions of this gas, exceeded only by agriculture. Managing methane emissions is possible throughout the supply chain, as reduction technologies are reasonably well understood and methane (natural gas) is a valuable natural resource. This can often be done at no cost or even at a profit. The challenge is to encourage the deployment of these reduction technologies through voluntary or regulatory means (see more information in IEA (nd.-b)).

58 See more information on renewable and clean energies in chapter I.

59 Scope 1 emissions are direct greenhouse gas (GHG) emissions caused by the use of assets that an organization owns or controls (for example, when a company burns fuels for its vehicle fleet). Scope 2 and 3 emissions refer to an organization's indirect emissions. The former arise from the purchase and consumption of electricity, steam, heat or cooling (for example, when a company consumes electricity from a distributor generated from a coal-fired power plant). Scope 3 emissions arise from the use of upstream or downstream assets that the company does not own or control (for example, when a company uses a third-party freight or passenger transportation service).

60 Advanced or second-generation biofuels are those produced solely from raw materials that do not directly or indirectly involve any change in land use. Conventional biofuels do represent a change in land use and therefore raise questions of sustainability. However, advanced biofuels have not reached the necessary technological and market maturity and are not yet commercially available. While conventional biofuels use sugars, starches, oil crops and animal fats as raw materials, advanced biofuels use non-food crops and agricultural and forestry waste. These materials are made up of three basic elements: cellulose, hemicellulose or lignin. See more information in Task 39 (n.d.).

61 See more information in IEA (2020b and 2020c); Kienzler and others (2023), and Beck and others (2020).

62 See more information on the firm at [online] https://orsted.com/, and on its transformation, in Ørsted (2021).

sector (national and foreign). There are a variety of options in this regard, but it is key to ensure legal, regulatory and tax security and stability within a framework of transparent and stable rules and agreements with strong long-term policies and signals.[63] Investments must be made both in more sustainable fossil energies (with emissions sequestration and management) and in low-carbon energies, and must be programmed together with the countries' fossil fuel exit strategy, which must provide for disinvestment in less sustainable fossil energies, as capacities are developed in more sustainable fossil energies and low-carbon sources. Investments in more sustainable fossil fuels refer to more sustainable use and management of these energies, particularly natural gas, through the uptake of technologies and innovations in practices and processes for carbon sequestration and emissions management in their production and use.[64] These technologies and innovations are also applicable to other industries with hard-to-reduce carbon emissions (cement, steel or chemical products, among others). Investments in these energies, accompanied by the transfer of knowledge and technology, can also promote the creation of capabilities to contribute to diversifying the productive structure of the countries of the region.

(iii) Include the analysis of climate risk and the social price of carbon (discount rate) in countries' fossil fuel exit strategies as a requirement for feasibility studies in relation to new or expanded fossil energy projects, in order to avoid potential investments in stranded assets. This is necessary to internalize the social costs of carbon emissions and other greenhouse gases, and thus to transfer responsibility for environmental and societal damage to those who cause it. Price signals allow economic agents to decide how to respond to the damage they generate, whether by reducing emissions, offsetting them, or paying the social cost of carbon.[65] This must be implemented in all economic activities (sectors and industries), for reasons of efficiency and equity. In the specific case of the hydrocarbon industry, it is necessary to reduce stranded asset risk when evaluating investment projects in supply chains (fuel exploration, extraction and refining activities and, in the case of vertically integrated companies, petrochemical production and energy and heat generation) and when considering investment alternatives and real options. This gives greater flexibility in the face of the uncertainty generated by the scenarios projected as part of the evaluations for each type of investment. However, the use of social pricing instruments also requires inclusion of the principle of common but differentiated responsibilities. Faced with energy needs and commitments in relation to global agendas, countries' capabilities and circumstances may require them to gradually adopt such instruments and even seek the support of international cooperation.

(iv) Adapt environmental regulations and standards to ensure the supervision, control and ex ante and ex post inspection of ecosystems in which hydrocarbon industry activities are carried out throughout supply chains, from exploration and fuel extraction to electricity generation. For this, renewable and clean energy industries must also be governed by the same regulatory framework and subject

63 See examples of incentives for investment in clean energy in Podestá and others (2022).

64 According to IEA (2020d), estimates that take into account both CO_2 and methane show a wide variation across different sources of coal and gas. Nonetheless, an estimated 98% of gas consumed today has a lower lifecycle emissions intensity than coal when used for power or heat (this comparison excludes any coal use for which gas could not be a reasonable substitute, such as coking coal used in steel production). This analysis shows that, on average, coal-to-gas switching reduces emissions by 50% when producing electricity and by 33% when providing heat. However, much uncertainty remains regarding the estimates of methane emissions from oil and gas operations globally, in particular, if comparisons are made over the long term. Accordingly, the emphasis should be on reducing emissions intensity and the deployment of large-scale carbon capture, utilization and storage (CCUS) technologies (IEA, 2020d).

65 The two main instruments used to allocate a social price to carbon are taxes and permits under the emissions trading system (Pizarro, 2021).

to the same standards, which applies, for example, to the supply chains of minerals critical to the energy transition. The idea is, on the one hand, to avoid downward competition and, on the other, to mitigate, prevent and manage the negative effects of the exploitation of natural resources, whether fossil or mineral, on the environment and communities. It is also necessary to expand the participation of key social stakeholders in control and oversight processes and improve information transparency —to be timely, complete, adequate and true— as well as timely and adequate access to it.[66] This will contribute to the formation of an ongoing process of legitimacy (ex ante and ex post) that endows the industry to with the social licence to operate.

(v) Adapt the fiscal regimes of hydrocarbon-producing countries for greater and better capture of economic rents from oil and natural gas and review capital expenditure mechanisms in order to direct these fiscal revenues towards investment in transforming the sector towards more sustainable and low-carbon fossil fuels. There are spaces to make these regimes more progressive, efficient and equitable and improve collection, which requires strengthening the capacities of public tax and customs administrations to properly inspect and oversee trade operations. Transforming the fossil energy sector requires investments and, therefore, the orientation of fiscal revenues from extractive activities towards a just energy transition. These revenues should drive capacity-building in energies in line with each country's fossil fuel transition strategy, including research, development and innovation, technology and infrastructure. This effort, which can also contribute to capacity-building for productive diversification, can occur through direct public investment in special purpose projects or vehicles. It can also be achieved indirectly, through sovereign investment funds for productive development. To this end, reviews must be undertaken of price stabilization mechanisms for fossil fuels and energies, which are usually complemented by sovereign funds that invest in highly liquid, low-risk financial assets. The purposes and rules of accumulation and decumulation should be adjusted as countries advance in the fossil fuel exit strategy (and as the volatility of their international prices impacts less on the economy). They can also be adjusted as their remaining resources are allocated to complement public investment for the energy transition, or to savings and stabilization funds for other macroeconomic contingencies.

(vi) Support companies that supply goods and services to the oil and natural gas industry in order to transform (diversify) their capabilities to supply goods and services to other industries, such as mining, metalworking, chemicals, variable renewable energies and hydrogen. Supplier networks already have cross-cutting capabilities that are applied in other industries, but the fossil fuel exit strategy requires some to be strengthened and new ones to be developed. For this reason, it is also necessary to promote investments and incentives in key segments and niches of the energy transition that serve as a basis for the provision of these networks' goods and services and contribute to the transformation of the fossil energy sector. This confirms the need to coordinate energy policy with productive development policy to promote and support supplier networks around the most sustainable fossil energy companies and low-carbon energies.

66 The Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement) is a tool for the protection of the environment and human rights whose objective is to ensure the rights of access to environmental information, public participation in environmental decision-making and access to justice in environmental matters in Latin America and the Caribbean. See more information at [online] https://www.cepal.org/en/escazuagreement. There are other mechanisms, such as the Extractive Industries Transparency Initiative (EITI) (see [online] https://eiti.org/), or the Open Government Partnership (OGP) (see [online] https://www.opengovpartnership.org/), which offer, among other things, a solid basis to improve and expand transparency, information and social participation in natural resource governance processes.

(vii) Dismantle generalized fossil fuels subsidies in accordance with the exit strategy, in order to reduce the fiscal cost and disincentives to investments in the transformation of the fossil energy sector. The scheduled elimination of generalized subsidies should align with the development of an adequate social safety net and the introduction of targeted transport and energy subsidies for low-income households, preferably through cash transfers to achieve greater efficiency in household spending.[67] Reducing the fiscal cost also requires increasing fiscal revenues from fuel consumption through specific taxes to cover social costs (given the environmental and social externalities it causes). These rents, which in some countries take the form of reserves for fuel price stabilization, can also be contributed to the fossil fuel exit strategy. Furthermore, as they approach their social cost, domestic fuel prices should reduce market inefficiencies and increase incentives for investment in more sustainable fuels and energies.

(viii) Promote regional integration of fossil energies, with infrastructure and new investments in energy integration, to enable the shared use of the most sustainable fossil energies, alongside low-carbon energies. The objective is to achieve energy security and resilience based on economies of scale in producing countries' fossil energy sectors and the complementarity of each country's energy supply, in particular for the energy transition, where this represents a fossil fuel exit strategy and a growing share of variable renewable sources, which are associated with power generation intermittency. Natural gas and the gas pipeline network in South America could offer an example of regional integration. This industry and its infrastructure could bring security and resilience to the transition and serve as a platform for the future development of the hydrogen industry. However, this requires a greater effort to coordinate policies at the national level, in order to achieve a greater degree of harmony and complementarity and synergy at the regional level (bilateral or multilateral). Coordination is necessary not only between energy and industrial development policies; it must occur across sectors and between energies, hence the need for a comprehensive energy policy to carry forward the fossil fuel phase-out strategy.[68]

D. Conclusions

In Latin America and the Caribbean, the hydrocarbon sector has been affected not only by external factors, such as international prices or geopolitical tensions, but also by domestic factors, such as economic situations, political decisions, regulatory frameworks or socio-environmental conflicts. All these factors have had repercussions of varying magnitude on the development of each country's hydrocarbon sector and have had positive or negative effects on its economic, environmental and social sustainability. The challenge of reducing the exposure of the region's countries to the geopolitics of fossil fuels also means taking into account the commitments assumed in global agendas on sustainable development and climate change and in the quest for energy security and sovereignty.

The region accounted for over 48% of the net addition of oil reserves worldwide between 2000 and 2020. However, if the Bolivarian Republic of Venezuela is excluded from the regional bloc, the addition turns negative, meaning there was a loss of oil reserves estimated at over 41% over this period. At the current production level, reserves will last less than a decade. This indicator reflects the loss of oil reserves, in

[67] For more information about good practices that help mitigate the negative effects of energy subsidy reforms on the well-being of low-income households, see Yemstov and Moubarak (2018).

[68] See chapter I for more information about how to achieve regional energy integration centred around renewable and clean energy.

order of magnitude, in Mexico, Ecuador, Trinidad and Tobago, Argentina and Peru. In the case of natural gas, the region accounted for just under 1% of the net variation in worldwide reserves, but, excluding the Bolivarian Republic of Venezuela, this figure was also negative by close to 40%, representing production availability of less than 11 years. The weak performance in hydrocarbon exploration in these countries also led to a decrease or only a small increase in their production volumes.

A hallmark of trends in fossil energies in the region, basically attributable to the hydrocarbon sector, has been the generalized decrease in the oil and natural gas surplus. Taken together with the fall in crude oil prices starting in 2015, the lower exports of raw materials (crude oil) and greater imports of derivatives (refined oil and LNG) have led to a drastic fall in foreign-exchange income in exporting producer countries. The trade balance fell continuously, from a surplus of US$ 76 billion in 2008 to deficits from 2015 on. After the global financial crisis of 2008–2009, the region posted a continuous trade balance deterioration caused by a considerable rise in imports of hydrocarbon derivatives (gasoline, fuel oil, diesel or gasoil and LNG).

The general downtrend in production —with some exceptions, such as Brazil and Colombia— resulted from the decline of mature fields in most countries and, of course, the declining trend in fossil fuel investments in the countries. At the same time, different potential deposits of non-conventional resources emerged, which could have a strategic role if exploited, given their magnitude. The contexts for this exploitation are very diverse, however. The development of the extra-heavy crude oil reserves of the Orinoco belt, in the Bolivarian Republic of Venezuela —which are being exploited only marginally— will depend on the institutional evolution of the sector and the country's macroeconomic situation, which raises questions regarding its viability, even in the medium term. Doubts also exist regarding the potential of Vaca Muerta, in Argentina, owing to issues of profitability, the magnitude of the investments required and macroeconomic stability. Brazil's pre-salt reserves seem to be the most promising for development, given the enormous productivity per well and the greater strength of the country's industry, led by its State company, Petrobras. To this is added the potential of Guyana's hydrocarbon supply. The challenge in this case will be establishing institutional structures to sustainably manage the new wealth, owing to the asymmetry between the country's current level of development and the magnitude of the resources mobilized by the direct, indirect and induced effects of exploiting the deep-water deposit in the basin that it shares with Suriname.

The global trend in energy investments is replicated in the region, where attention has turned to the development of renewable energies, at least since 2015. Unlike investments in fossil fuels, these investments seem to be decoupled from international fuel price cycles and, therefore, to a certain extent from the associated fiscal revenues as well. The downtrend in market prices after the commodity boom and the industry's cost control and adjustments affected hydrocarbon companies' economic and financial situation, which in some cases was already fragile after the previous years of borrowing and inadequate management of cash flows, which led to a decrease in the investments by many companies in the sector.

Thus, State oil companies in Latin America and the Caribbean were unable to increase the pace of investments to develop their abundant —mostly non-conventional— hydrocarbon reserves. Private energy investors, both traditional and new, were also seen to be more inclined to invest in renewable energy than in the large-scale development of fossil fuels. State oil companies continue to lead regional oil and natural gas production, with over three quarters of the total in the region and, directly or indirectly, they control the bulk of proven reserves.

This report is framed in this complex regional scenario, with a group of countries that have very different situations and capacities both at the micro level —the hydrocarbon industry or energy sector— and at the macro level. Hence the need to invest in a just transformation of the fossil energy sector to make it into a low-carbon sector. This requires a progressive shift away from fossil-based energy systems towards low-carbon energy systems, in order to reduce dependence on fossil fuels, increase energy security and sovereignty, and improve access to renewable and clean energy sources, as well as their coverage.

This proposal should be part of a comprehensive energy policy with guidelines for planning a fossil fuel phase-out strategy by gradually reducing the systems based on these energy sources. This implies transforming the hydrocarbon sector and improving the governance of fossil resources in the countries of the region.

The guidelines may include those listed below:

(i) Transform State oil companies into State energy companies to develop capabilities to diversify investments (towards more sustainable and low-carbon energy sources), optimize rent capture, maximize operational efficiency, promote technological innovation and ensure good corporate governance.

(ii) Promote investment in more sustainable fossil energies (with emissions sequestration and management) and in low-carbon energy to close the gaps that condition energy security and sovereignty, and guarantee access and coverage of homes and businesses.

(iii) Adapt environmental regulations and standards in order to guarantee the supervision, control and ex ante and ex post inspection of the ecosystems in which hydrocarbon industry activities are carried out, in order to avoid policies that encourage downward competition and to improve information transparency and the participation of civil society in environmental evaluation and social licensing processes.

(iv) Adapt fiscal regimes to increase and improve the capture of economic rents from oil and natural gas (to make regimes more progressive, efficient and equitable) and shift the sector's fiscal revenues towards investment in transforming the energy and fossil fuel sector.

(v) Dismantle generalized subsidies on fossil fuels, using distribution criteria, such as targeted subsidies or transfers to low-income households.

(vi) Promote regional integration of fossil energies where the infrastructure exists, as well as new investment where shared use with other low-carbon energies is feasible.

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CHAPTER

VII

The transition to a new, more efficient, inclusive and sustainable mining sector

Introduction

A. The governance of mining activities in Latin America and the Caribbean

B. The presence of Latin America and the Caribbean in the global mining industry

C. The performance of the mining sector in Latin America and the Caribbean

D. The outlook for mining in Latin America and the Caribbean

E. Public policy messages to further progress towards the mining sector's transition

Bibliography

Annex VII.1

Introduction

This chapter will provide an overview of mining in Latin America and the Caribbean between 2000 and 2021 and will examine the following aspects: the relative size and importance of the region's mining sector in terms of the global mining industry; its performance and the impact it has on the economy and society; governance of the sector; how the sector reacted during the coronavirus disease (COVID-19) crisis and the conflict between the Russian Federation and Ukraine; the outlook for the growth of the world economy, the energy transition, the regionalization of value chains and technological innovation; and the challenges involved in the mining sector's contribution and transition to a type of structural change that will increase the ability of the countries in the region to achieve the Sustainable Development Goals.

The level of development attained by the mining sector differs a great deal from country to country. Mining in Mexico, Peru and the Plurinational State of Bolivia dates back to the precolonial era and has, over time, become a fundamental factor in the way these countries have positioned themselves in the global economy. In other countries, such as Ecuador and Uruguay, large-scale mining projects are a quite recent development, while others, such as Costa Rica, produce almost no minerals at all and mining exports play no material role in their economies.

The time period covered in this chapter (2000 to 2021) encompasses the commodities supercycle. Concessions and investments, along with the creation and capture of rents, have followed the same upward and downward curves as prices on international markets have, but pro-mining policies have remained in place, and production in the sector and its exports continue to climb.

There are numerous challenges to be met by the sector in terms of sustainability, including the integration of environmental considerations into all stages of the life cycle of mineral resources, social inclusion, the creation of an effective system of governance and the need to find ways of reducing mining activity's negative environmental, social and economic impacts. In order for mining to be sustainable, the roles, rights and responsibilities of all stakeholders need to be clearly defined, and new resource governance tools will have to be introduced.

To optimize the benefits of mining activity, a solid institutional structure is needed that can assign clear-cut roles and responsibilities to the various public and private actors concerned. This presupposes the existence of effective and efficient environmental, social and economic policy and regulatory frameworks that will minimize the negative impacts of mining operations on the ground, along with mechanisms for enforcing environmental, social, labour, economic and fiscal standards.

As the mining countries in the region are focused on the upstream linkages of the global value chain (mostly in extraction), a strategic approach is required to identify the opportunities and challenges propelled by global shifts in terms of production linkages and value addition, particularly in the case of minerals that are of key importance for the energy transition and the electromobility.

All of these subjects will be explored in the following sections.

A. The governance of mining activities in Latin America and the Caribbean

By law, non-renewable subsurface resources in the region, including minerals, are national assets and are therefore administered by the State. The central government carries out these administrative duties except in Argentina, where this competency falls upon the provincial governments.

In a number of countries, including some that embrace free market policies and others that follow a more nationalist, redistributive model, the mining sector has enjoyed government support because it is seen as an engine of growth. The only exceptions are Costa Rica, where open-pit mining of metal ores was banned in 2010, and El Salvador, which introduced such a prohibition in 2017.

The emphasis has been on promoting private investment in mining activities, even in Chile, home to the National Copper Corporation of Chile (CODELCO), which is the world's largest State-owned copper producer. In fact, private investment in the Chilean mining sector climbed from 67% to 71.2% of the total between 2000 and 2021.

Concessions are the mechanism used to promote mining investment, and concession holders are left to decide how much to invest, how much to produce and where to sell the ore that they extract (Chávarry, 2015). In Chile, lithium is an exception to this rule, however; in order to ensure a certain level of value addition, private concession holders are required to sell a portion of their output to industries located in the country (Poveda, 2020).

Mining companies are subject to national taxation laws, although in Argentina the provincial authorities also set and collect taxes. Taxes on earnings or profits are the main tool used to capture a portion of mining rents, and the rates applied tend to be much the same as those applied to other business activities (see annex VII.1). In Argentina, Brazil, Colombia, Peru, the Plurinational State of Bolivia and, more recently, Mexico, mining royalties are also collected on the volume of output or on sales.

In some cases, extraordinary temporary taxes have been levied, with examples including the temporary tax collected between 2006 and 2011 in Peru under the Mining Programme for Solidarity with the People and the mining royalty introduced in Chile to help pay for reconstruction work following the 2010 earthquake.

Tax stability agreements covering the whole duration of mining projects have limited governments' ability to modify their tax policies in response to changing circumstances. In addition, the governments of a number of countries have applied special provisions covering tax expenditures and have granted tax incentives to mining companies, with the result that the sector's real tax payments are less than their nominal contributions (ECLAC, 2020).

In Peru, a portion of mining rents are deposited in the Tax Stabilization Fund and, in Chile, a portion of such rents is paid into the Pension Reserve Fund and into the Economic and Social Stabilization Fund, which were set up in 2006 and 2007, respectively. The percentage of GDP represented by savings and stabilization or investment funds varies from country to country (see table VII.1).

Table VII.1
Latin America and the Caribbean (7 countries): balances in selected sovereign funds, 2021
(Billions of dollars and percentages of GDP)

Fund	Country	Assets *(Billions of dollars)*	Percentage of GDP, 2021
Fund for the Productive Industrial Revolution (FINPRO)	Bolivia (Plurinational State of)	1.2	2.9
Economic and Social Stabilization Fund (FEES)	Chile	2.5	0.8
Pension Reserve Fund (FRP)	Chile	7.5	2.4
Saving and Stabilization Fund (FAE)	Colombia	3.9	1.2
Budgetary Revenue Stabilization Fund (FEIP)	Mexico	4.8	0.04
Panama Savings Fund	Panama	1.5	2.2
Fiscal Stabilization Fund (FEF)	Peru	4.3	0.002
Heritage and Stabilization Fund (HSF)	Trinidad and Tobago	5.6	25

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official information.

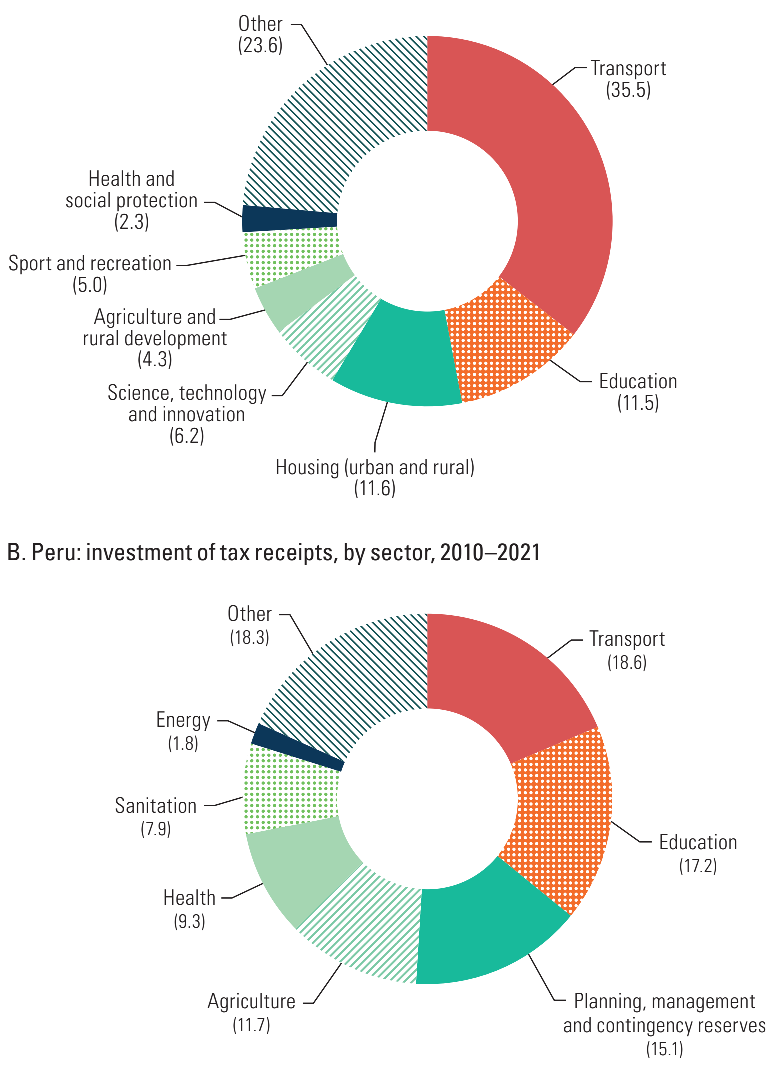
In some countries, subnational governments are the ones that collect the levies on mining rents and that decide how to use those funds. In others, the central government determines what those resources can (investment) and cannot (current expenditure) be used for. In Chile, a portion of the revenues from copper go to the armed forces (10% of CODELCO sales), while, in Peru, some of those funds are earmarked for research in public universities; in the Plurinational State of Bolivia, those receipts are used to promote mining and drilling (Viale, 2015). Colombia has recently decided to allocate a portion of mining royalties for environmental protection.

In Peru and Colombia, subnational governments allocate both the tax receipts from mining activities and the other revenues that are at their disposal primarily for investment in the transport and education sectors (see figure VII.1).

Figure VII.1
Colombia and Peru: subnational governments' allocation of revenues from mining activity
(Percentages)

A. Colombia: receipts of the General Royalties System, by sector, 2012–2021

B. Peru: investment of tax receipts, by sector, 2010–2021



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of National Planning Department of Colombia, "Mapa Inversiones" [online] https://mapainversiones.dnp.gov.co/ and Ministry of Economy and Finance of Peru, "Transparencia Económica" [online] https://apps5.mineco.gob.pe/transparencia/Navegador/default.aspx.

While some progress has been made in increasing the transparency of the mining sector, there is still a long way to go. In all, 57 countries around the world have signed on to the Extractive Industries Transparency Initiative (EITI), including 11 Latin American and Caribbean countries: Argentina, Colombia, Dominican Republic, Ecuador, Guatemala, Guyana, Honduras, Mexico, Peru, Suriname, and Trinidad and Tobago. Chile applied for accession in 2023, but there are some mining countries in the region, such as Brazil, that are not yet members.

ECLAC (Jorrat, 2021 and 2022) has pointed to some key courses of action to be taken to close the existing transparency gaps in the mining industry in Argentina, Chile, Peru and the Plurinational State of Bolivia. First, information about the taxes paid by mining companies has to be made more readily available, disaggregated by company and by tax instrument. Second, the actual beneficiaries of mining investments need to be identified. Third, the information that is provided has to be more complete and timelier. And finally, regulations need to be introduced concerning the disclosure of mining companies' financial statements, particularly in the case of those that are not publicly traded.

In the 2000s, a number of mining countries established national environmental authorities. Mexico founded such an authority in 2000; Peru did so in 2008, Chile in 2010 and Guyana in 2017. Brazil had established an environmental authority back in 1992. Colombia was the first country to introduce regulations requiring the preparation of environmental impact assessments for mining projects, and this practice has since spread throughout the region, although the corresponding requirements vary a great deal across countries. The effectiveness of these assessments needs to be improved upon, however, and a human rights approach has yet to be incorporated into these mechanisms.

Some ground was lost in some countries during the 2010s, as the management of environmental permits in Colombia became less effective and, in Peru, the use of environmental impact assessments was weakened, as were the Office of Environmental Assessment and Inspection (OEFA) and the Ministry of the Environment (Salazar, 2019).

Public policies and corporate strategies for reducing global warming by cutting greenhouse gas (GHG) emissions in the production, refining and transport of mining products are still just getting off the ground. For example, mining is not even identified as a specific sector in the mitigation component of the nationally determined contributions (NDCs) submitted under the Paris Agreement approved at the twenty-first session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (Samaniego and others, 2019).

Chile is an exception, since it has included the use of green hydrogen in mining activities in its recently updated objectives and actions for the energy sector in its NDC (Samaniego and others, 2022). Chile has also been working to boost the efficiency of energy and water use in the mining sector and to increase the use of alternative sources by, for example, promoting the desalination of seawater and the generation of wind and solar power. Private companies and CODELCO have launched strategies for producing copper more sustainably in response to the changing nature of demand on the international market while safeguarding human rights and protecting the environment at all stages along the copper supply chain. Although the very idea of "sustainable mining" is controversial, given the fact that these are non-renewable resources and in view of the pressure that mining activity puts on ecosystems, it is important for countries to continuously improve the efficiency of their energy and water use and to achieve neutrality in the mining sector's GHG emissions.

The presence of Indigenous Peoples is constitutionally recognized by 14 countries in the region and, in 13 of them, those Peoples' rights to their territories is also recognized. The delimitation and legal establishment of those territories is a slow, complex and costly process, however, (ECLAC/FILAC, 2020). More of the Latin America and Caribbean countries have ratified the International Labour Organization (ILO) Indigenous and Tribal Peoples Convention, 1989 (No. 169) than those of any other world region (15 out of 23 countries that have ratified are in Latin America and the Caribbean). Mexico was the first to do so, in 1991, while Chile is the one to have done so most recently, in 2007. The Bolivarian Republic of Venezuela, Ecuador, Mexico and the Plurinational State of Bolivia have enshrined the principle of free, prior and informed consent (article 6 of ILO Convention No. 169) in their Constitutions, and a number of other countries have introduced specific legal frameworks for its practical application.

The problems that have hindered efforts to implement genuine consultations with a view to obtaining free, prior and informed consent have eroded the legitimacy of that tenet, however, and have sharpened Indigenous Peoples' interest in invoking article 7 of ILO Convention No. 169 to reaffirm their right to their territories and to self-determination and autonomy. One example is provided by the Autonomous Territorial Government of the Wampis Nation in the northern Peruvian Amazon, which defended the right of the Indigenous Peoples of that Nation to consultation when, during the COVID-19 pandemic, various governments tried to hold virtual consultations instead in order to avoid delaying development projects that were under way. (For a more detailed discussion of this case, see ECLAC and others, 2020, and Dammert, 2020).

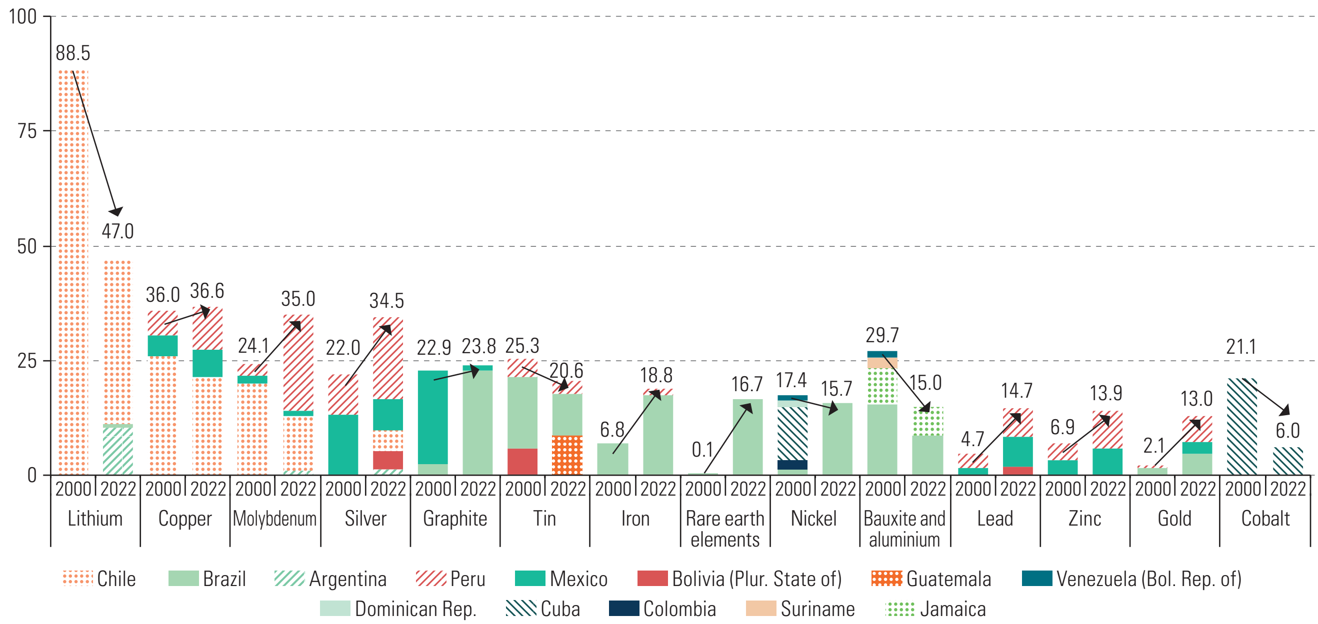
Other sectors of society have also demanded to be consulted about mining projects being undertaken in areas where they live and work. Between 2013 and 2018, public consultations were held concerning mining investments in nine municipalities of Colombia, and those investment projects were rejected in each case. During that period, another 135 consultation processes were also under way. Ultimately, the Constitutional Court of Colombia decided that such consultations were not an appropriate mechanism for arriving at decisions of that type and instead found that greater coordination and consultation between national and local authorities were called for. In Peru and Argentina, non-indigenous groups have also demanded the right to be consulted about mining projects having an impact on their lives.

B. The presence of Latin America and the Caribbean in the global mining industry

Worldwide, developed and emerging economies' demand for critical minerals will continue to climb as they transition towards clean forms of energy and the use of electric vehicles. The region has large reserves of these minerals and is a major producer of lithium and copper, but its share of the world market has been slipping in recent years. Chile has vast reserves of these two minerals, while Peru has copper, silver and molybdenum, Brazil has iron, tin, graphite and rare earth elements, and Mexico has large silver deposits (see figure VII.2).

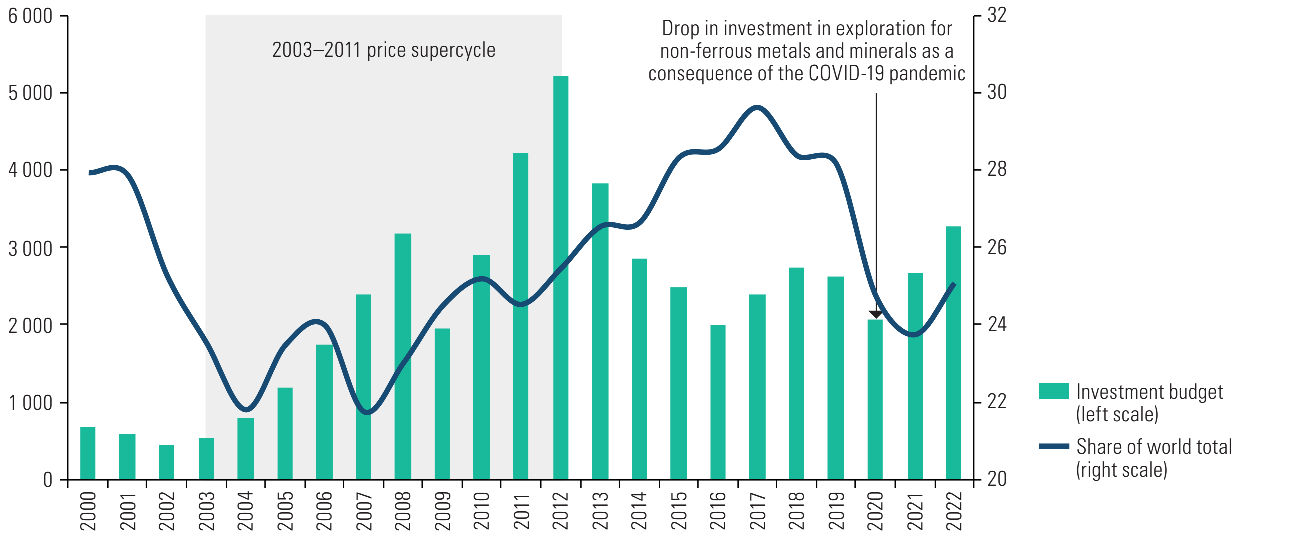
Latin America and the Caribbean have consequently attracted a large part of global investment in mining exploration, taking in about one fourth of the world total over the past two decades (see figure VII.3). As exploration for new reserves has also been very actively pursued in other world regions during this period, however, the region's share of global mineral reserves has actually shrunk.

Figure VII.2
Latin America and the Caribbean (13 countries): shares of global reserves of selected minerals, 2000 and 2022
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United States Geological Survey (USGS), *Mineral Commodity Summaries 2023*, Washington, D.C., 2023.

Figure VII.3
Latin America and the Caribbean: investment in exploration for non-ferrous metals and minerals and share of the world total, 2000–2022
(Millions of dollars and percentages)

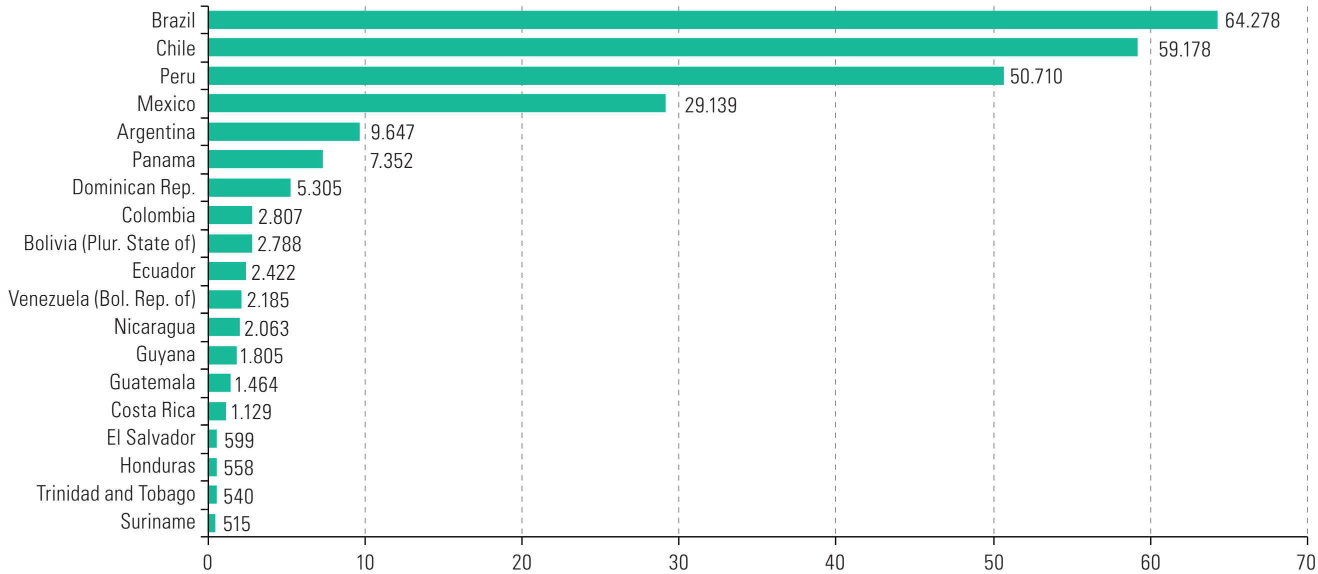


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of statistical information from S&P Global Market Intelligence.
Note: The figures given for investment in exploration for non-ferrous metals and minerals include expenditures on exploration for gold, basic metals, platinum, diamonds, silver, rare earth elements, potash, phosphate and other hard rock metals. They do not include expenditures on exploration for iron ore, coal, aluminium, petroleum, natural gas or various industrial minerals.

In 2020, investment in mining exploration declined as a result of the COVID-19 pandemic and the attendant restrictions placed on production activities. Nevertheless, as uncertainty around the possible closure of mining projects was overcome and as metal prices continued their upward climb in 2021, investment in exploration soon regained its pre-COVID levels. In 2022, investment for exploration in the region totalled US$ 3.261 billion, which was the highest point reached since 2013.

Announcements of foreign direct investments (FDI) in mining have primarily concerned Brazil, Chile and Peru, followed by Mexico (see figure VII.4). In countries with smaller economies (for example Guyana and Suriname) or less diversified economies (such as Peru and Chile), the mining industry is the largest recipient of FDI. Investors in mining exploration are chiefly interested in finding gold, silver and copper. FDI announcements concerning metal ore were down sharply during the COVID-19 pandemic (plunging by 86% between 2019 and 2020), but between 2020 and 2021 they bounced back, rising by 80%.

Figure VII.4
Latin America and the Caribbean (19 countries): announcements of foreign direct investment in metal mining, by destination country, 2003–2022
(Billions of dollars)

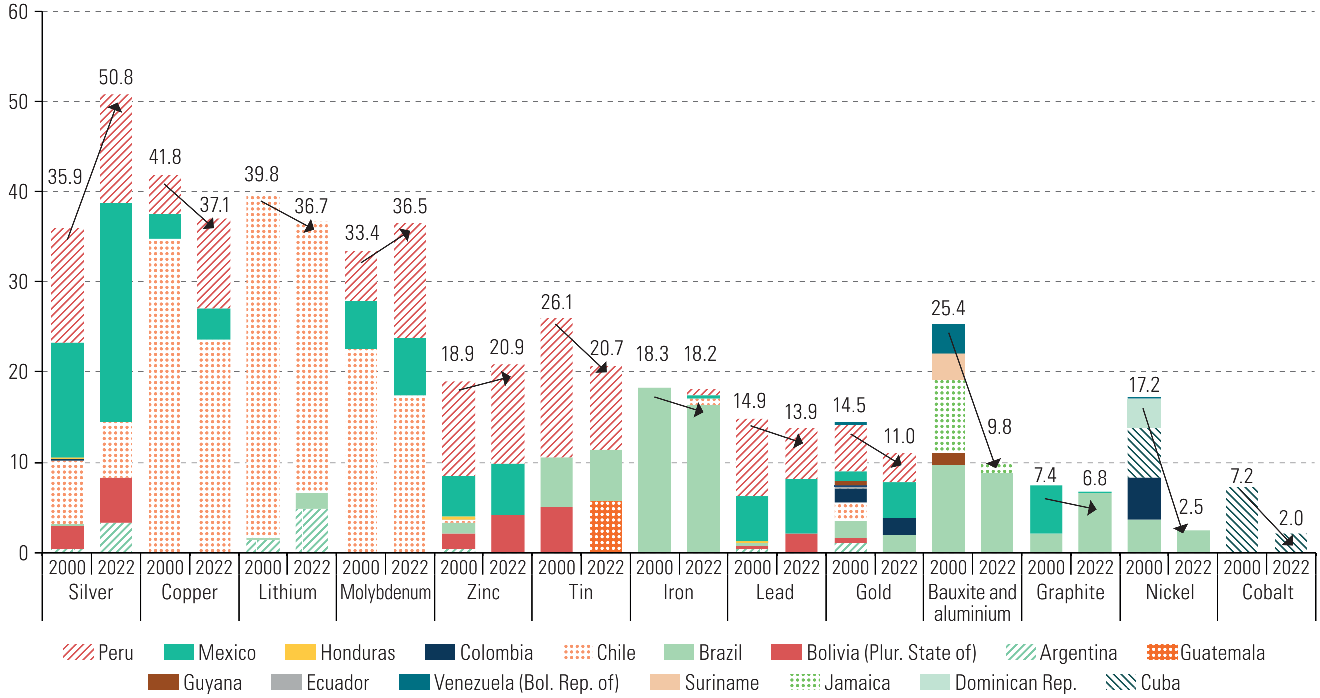


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of statistical information from Financial Times, fDi Markets.
Note: Data updated to 30 September 2022.

More investments in mining exploration in the region are announced by Canada than any other country, with the bulk of those investments being sited in Mexico and Chile. Investments in mining exploration in Peru come from a wider range of countries (the United Kingdom, China, Canada, Mexico, the United States, Peru, Australia, Brazil, Japan, Switzerland and the Republic of Korea, in that order). Mexico and Brazil also have large locally owned mining companies that are active in the region and around the world. Examples include Brazil's Vale, the world's largest producer of iron and nickel, which has mines in its home country, Canada, Indonesia and New Caledonia, along with foundries in Oman and China, and Grupo Mexico, which is Mexico's and Peru's biggest copper producer and has operations in the United States and Spain.

In 2022, the region accounted for 51% of world production of silver, 37% of the global output of copper, molybdenum and lithium, 21% of the world's total production of tin and zinc, and 18% of all iron ore produced that year (see figure VII.5). Chile, Peru, Mexico, Brazil and the Plurinational State of Bolivia are among the leading producers of various minerals and metals. With the exception of silver and, to a lesser extent, molybdenum and zinc, however, the region's share of global mining production declined between 2000 and 2021 as production in China ramped up.

Figure VII.5
Latin America and the Caribbean (16 countries): shares of world production of selected minerals, 2000 and 2022
(Percentages)

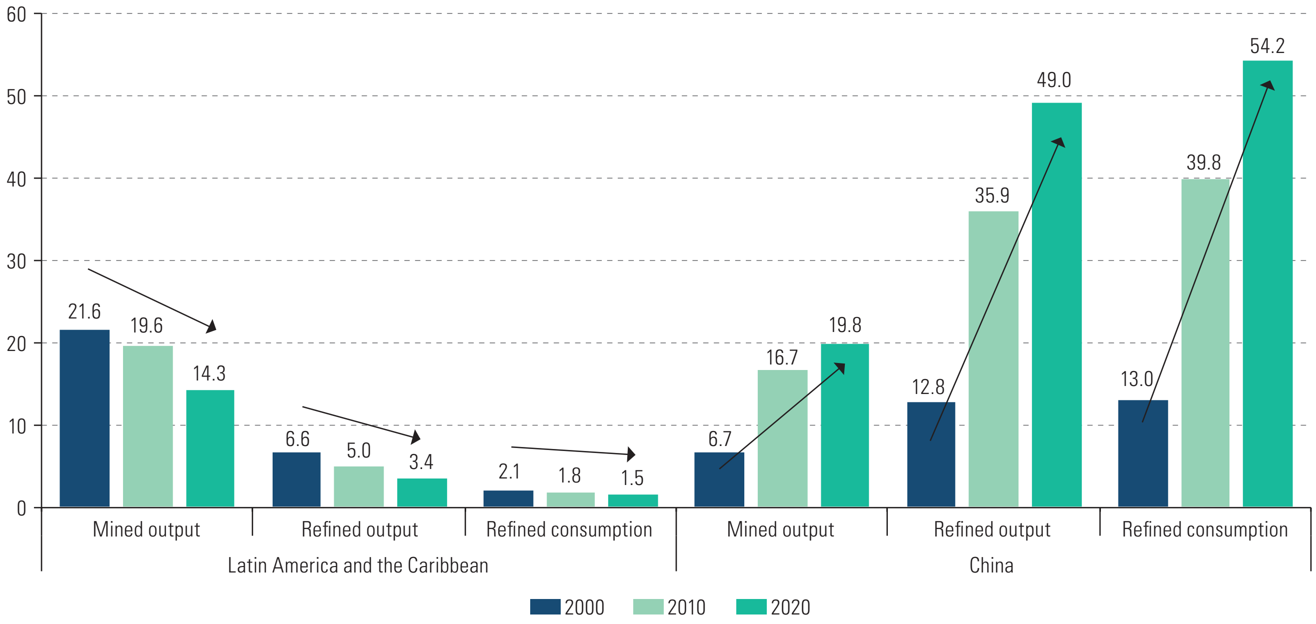


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United States Geological Survey (USGS), *Mineral Commodity Summaries 2023*, Washington, D.C., 2023.

In 2021, Chile, Peru and Mexico met nearly 40% of the global demand for mined copper, thus establishing a strategic position for themselves in the world copper market. However, the region's increased production put greater pressure on the environment but did not achieve any advances in terms of value added, while China made huge qualitative and quantitative strides in its production and consumption of refined copper, aluminium, nickel, lead, tin and zinc. In the past few decades, China has moved up along the metallurgical value chain, coming to account for almost 50% of the output and over 50% of the consumption of various refined metals at the world level (see figure VII.6).

The Latin American and Caribbean region runs a surplus on its trade balance for mining resources, and its trade in those resources showed strong growth from 2000 to 2021, not only in monetary terms but in terms of volume as well (see figure VII.7). In the first two decades of this century, the volume and value of exports grew at average annual rates of 9.3% and 3.2%, respectively. The boom in mineral prices seen between 2003 and 2011 translated into a considerable expansion of the mineral and metal exports of the countries of the region.

Figure VII.6
Latin America and the Caribbean (7 countries)[a] and China: mined output and refined output and consumption, 2000, 2010 and 2020
(Percentages)

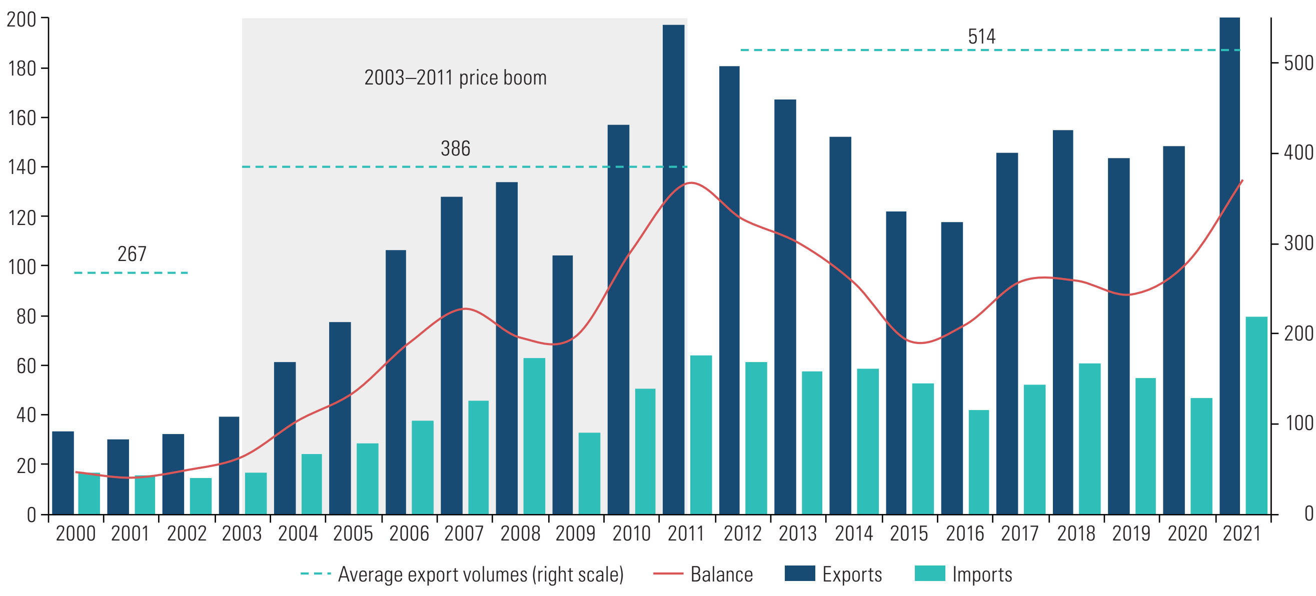


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, "Commodity Markets" [online] https://www.worldbank.org/en/research/commodity-markets.

Note: The output and consumption of refined products are included in the figures given for copper, aluminium, nickel, lead, tin and zinc, along with any significant amounts of recycled material.

[a] Brazil, Chile, Jamaica, Guyana, Mexico, Peru and the Plurinational State of Bolivia.

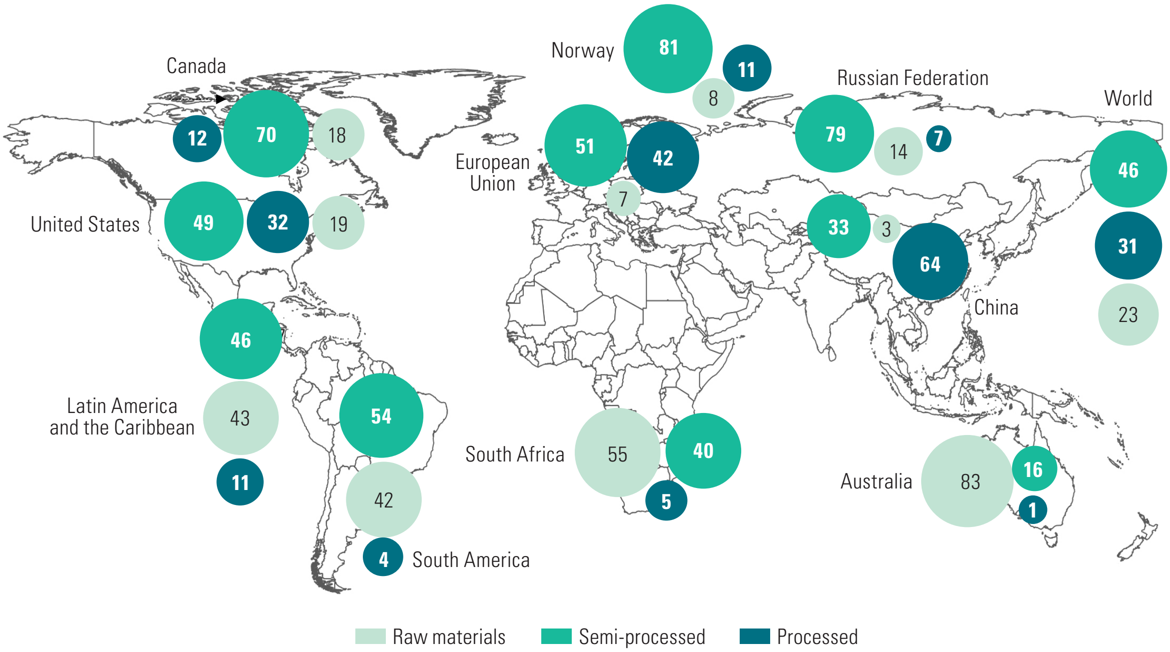
Figure VII.7
Latin America and the Caribbean: trade in minerals and metals and export volumes, 2000–2021
(Billions of dollars and millions of tons)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database.

The minerals that the region exports incorporate little added value, however. Raw materials represent 43% of the region's exports of minerals and metals, which is far greater than the average share of raw materials in the sector's exports at the global level (approximately 23%) (see map VII.1). China is the world's leading producer and consumer of refined minerals and metals.

Map VII.1
Average world exports of mineral and metals, by degree of processing and by region, 2017–2021
(Percentages)

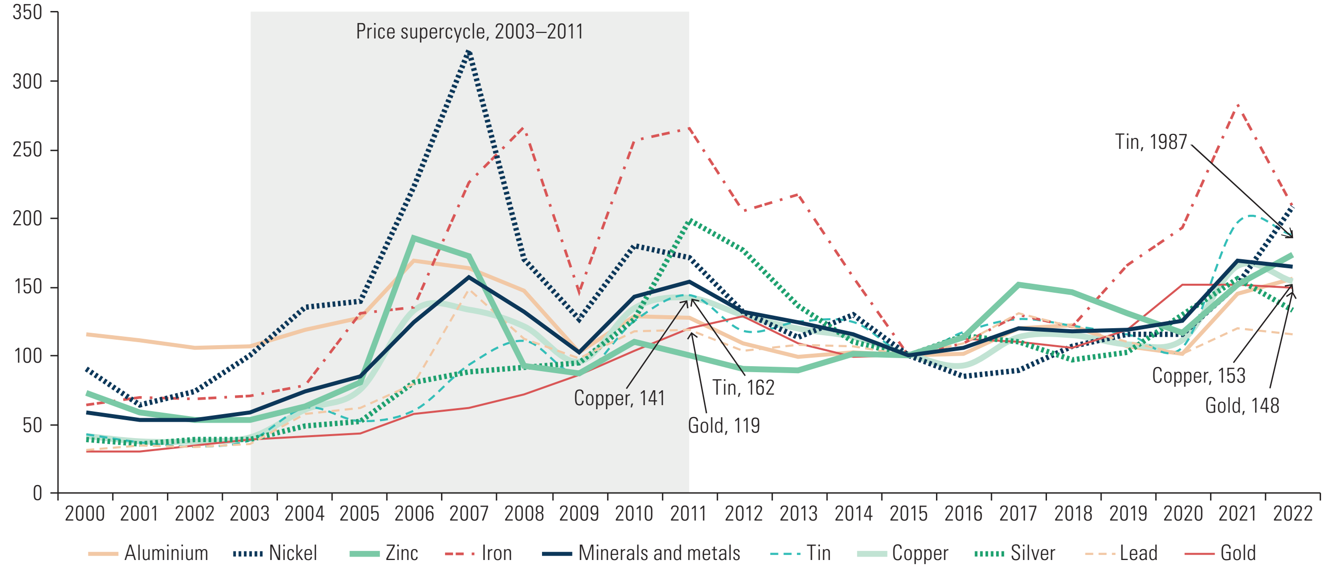


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of United Nations, UN Comtrade Database.
Note: Figures for a total of 837 products listed in the Harmonized Commodity Description and Coding System (HS) were selected and tabulated to arrive at the calculations reflected in the above map. The calculations themselves are based on ECLAC, *International Trade Outlook for Latin America and the Caribbean* (LC/PUB.2018/20-P), Santiago, 2018 (LC/PUB.2018/20-P), Santiago, 2018, which correlates with the products covered in this study.

C. The performance of the mining sector in Latin America and the Caribbean

The global economic growth phase that began in the early 2000s, which was largely driven by China, included a supercycle in metal and mineral prices that spanned the years between 2003 and 2011. The short-lived drop in prices triggered by the 2008–2009 global financial crisis was followed by a recovery up to 2011 that then gave way to another downtrend (see figure VII.8). The 2020 worldwide recession caused by the quarantines and lockdowns introduced in an attempt to contain the expansion of the COVID-19 pandemic caused mineral prices to tumble on world markets (with the exception of gold, which was prized as a means of storing wealth and maintaining liquidity). Despite the drop in mineral prices on international markets, however, prices remained well above marginal production costs, which means that there was actually no justification for the reduction in standards or the loosening of fiscal, environmental or social requirements introduced by some countries during the pandemic in order to buoy mining investment (Monge, 2020).

Figure VII.8
International mineral and metal price indices, 2000–2022
(Index: 100=2015)



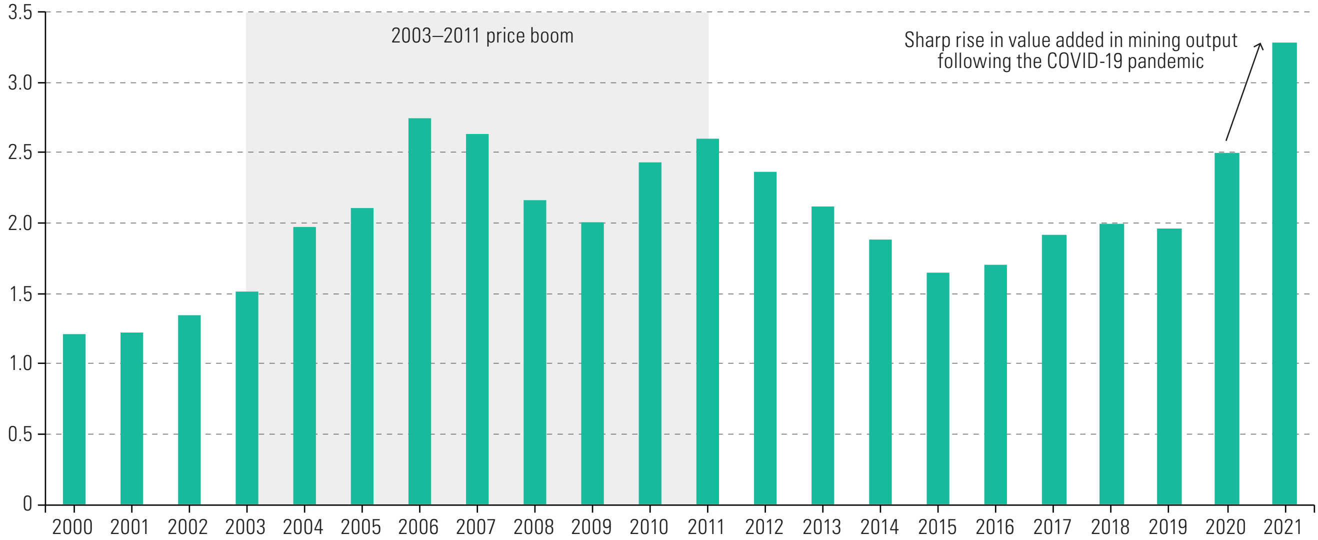
Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of World Bank, "Commodity Markets" [online] https://www.worldbank.org/en/research/commodity-markets.
Note: Prices are in constant 2010 dollars.

In 2021, the prices for metals such as copper, tin, iron and gold rebounded to the peak levels seen in 2011 during the latest mineral price supercycle. This was primarily due to the reactivation of world demand, particularly from China. In the early months of 2022, these upward trends were strengthened by the conflict between the Russian Federation and Ukraine. The prices of aluminium, nickel, titanium and palladium, in particular, rose sharply during this period because both parties to the conflict are major world producers of those metals. The prices of the various minerals and metals have behaved differently, however, owing in part to factors that are specific to each product.

Mineral and metal production provides a significant amount of added value in various economies of the region (see figure VII.9), albeit with ups and downs in line with the international price trends for these products. For example, mining output represented 8.4% of GDP in 2021 for the Plurinational State of Bolivia, 16.2% for Chile and 8.7% for Peru. A widespread expansion of economic activity came in the aftermath of the COVID-19 pandemic, although the performance of the mining sector varied from country to country. Most of the countries regained their pre-pandemic production levels, however.

The production linkages involved in mining and drilling activities include backward linkages with suppliers of goods and services, horizontal linkages with other users of the same infrastructure or services, forward linkages with the operators that add value to the resources that have been extracted and fiscal linkages with the entities benefiting from the use of economic rents. Generally speaking, the linkages formed by the region's mining sector have been determined by the corporate strategies of the mining companies themselves, which focus on minimizing costs and maximizing efficiency or legitimacy, or by the interests of private investors that have detected a business opportunity in the provision of services to the mining industry.

Figure VII.9
Latin America and the Caribbean (11 countries):[a] mining value added, 2000–2021
(Percentages of GDP)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of "Country profiles", CEPALSTAT [online database] https://statistics.cepal.org/portal/cepalstat/national-profile.html?theme=1&country=atg&lang=en.

Note: The mining activities reflected in these figures are the extraction of metal-bearing ores, the working of other mines and quarries, and support services for the working of mines and quarries. Values in millions of current dollars were used in calculating the amount of value added as a percentage of GDP. In the cases of Brazil, Ecuador, Guatemala and Peru, the values used for 2021 are approximations.

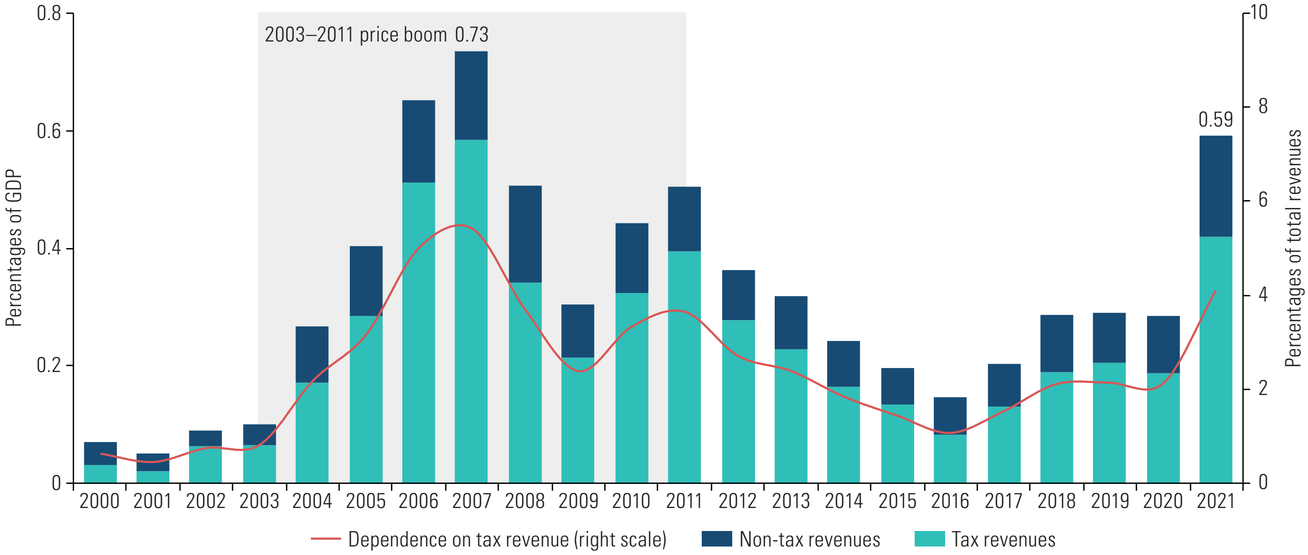
[a] Argentina, Brazil, Chile, Colombia, Ecuador, Guatemala, Jamaica, Mexico, Nicaragua, Peru and the Plurinational State of Bolivia.

In Chile, clusters of mining service providers have formed that do not only cater for mining operations in the country but also export their services. In Peru, the biggest companies view the mining services export activity of corporations in Chile and Australia as a model to emulate, while the smaller firms are working to secure a share of the business generated by the local demand for these goods and services (Ramírez Farías, 2019).

The tax revenues generated by the mining sector are considerable in a number of the region's countries. Tax receipts from the mining sector are equivalent to 3.01% of GDP in Chile, 1.66% in Peru and 0.95% in the Plurinational State of Bolivia. The simple and weighted averages of tax revenues provided by the mining sector in the region come to nearly 0.68% and 0.59% of GDP, respectively. This source of tax receipts has mirrored international price trends. The fact that State reliance on tax revenues from mining activity increased during the price boom and declined thereafter (see figure VII.10) indicates that government budgets are vulnerable to international price volatility.

Large-scale mining in the region exists alongside artisanal, medium- and small-scale mining operations, and the sector therefore exhibits widely varying levels of productivity and impact. It is estimated that around 2.4 million persons, in addition to their families and their suppliers of goods and services, are directly engaged in informal or illegal small-scale and artisanal mining, mainly for gold (see map VII.2). Illegal mining, especially for gold, is a problem in a number of countries in the region. It is estimated that, as of 2016, a sizeable share of gold production —28% in Peru, 30% in the Plurinational State of Bolivia, 77% in Ecuador, 80% in Colombia and between 80% and 90% in the Bolivarian Republic of Venezuela— was mined and exported illegally (Quijano and others, 2020; CooperAcción, 2019).

Figure VII.10
Latin America and the Caribbean (11 countries): tax revenues generated by extractive activities, by type of instrument, and dependence on tax receipts from mining activity[a]
(Percentages of GDP and of total revenues)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of the ECLAC database on fiscal revenues from non-renewable natural resources in the region.
Note: Weighted averages of tax revenues for each country. Dependence on tax revenues is measured as the share of total central government revenues (mandatory unrequited payments) represented by tax receipts from extractive activities.
[a] Argentina, Brazil, Chile, Colombia, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Peru and the Plurinational State of Bolivia.

Map VII.2
Latin America and the Caribbean: informal or illegal small-scale and artisanal mining
(Estimated number of miners)

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Artisanal and Small-scale Mining (ASM), "ASM Inventory" [online] http://artisanalmining.org/Inventory/ [accessed on 27 January 2022].
Note: The data are for the latest year available.

Medium- and large-scale mining operations in the region and throughout the world are capital-intensive operations requiring highly qualified personnel that the rural societies in which mining activities are generally located are unable to provide. A demand for unskilled labour is primarily created during the initial stage, when basic infrastructure has to be built, but few direct unskilled jobs are created during the production phase (see table VII.2).

Table VII.2
Latin America (8 countries): employment in the mining sector, 2019–2021
(Percentages of total employment in each country)

Country	Year	Employment in the mining sector
Argentina	2019	0.21
Bolivia (Plurinational State of)	2020	15.00
Brazil	2022	0.58
Chile	2022	3.08
Colombia	2019	0.92
Ecuador	2020	0.76
Mexico	2020	1.86
Peru	2021	1.26

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Portal Nacional de Datos Abiertos of Argentina, "Empleo total y por sector de actividad" [online] https://datos.gob.ar/dataset/sspm-empleo-total-por-sector-actividad; Ministry of Mining and Metallurgy of the Plurinational State of Bolivia, "Ministro de Minería participa del lanzamiento del programa global PlanetGold", 2020 [online] https://mineria.gob.bo/documentos/noticias.php?pvnoticia=1267&codigo=eyJzdWIiOiIxMjM0NTY3ODkwIiwibmFtZSI6IkpvaG4gRG9lIiwiaWF0IjoxNTE2MjM5MDIyfQ; Ministry of Labour of Brazil, "Programa de Disseminação das Estatísticas do Trabalho" [online] http://pdet.mte.gov.br/novo-caged; National Institute of Statistics of Chile, "Ocupación y desocupación" [online] https://www.ine.cl/estadisticas/sociales/mercado-laboral/ocupacion-y-desocupacion; National Mining Agency of Colombia, *Boletín Estadístico Minero 2019* [online] https://mineriaencolombia.anm.gov.co/sites/default/files/docupromocion/BOLETIN2019-160222.pdf; National Institute of Statistics and Censuses (INEC) of Ecuador, "Ecuador - Encuesta Estructural Empresarial 2020, vol. I, vol. II, Establecimientos, TIC" [online] https://anda.inec.gob.ec/anda/index.php/catalog/920/get_microdata; Ministry of Energy and Mines of Peru, "Boletín Estadístico Minero" [online] https://www.gob.pe/institucion/minem/colecciones/6-boletin-estadistico-minero; Mexican Geological Service, *Anuario Estadístico de la Minería Mexicana, 2020*, Mexico City, 2021 [online] https://www.sgm.gob.mx/Gobmx/productos/Anuarios-historicos.html.

Note: "Total employment" refers to the employed population in Argentina; to the working population in Chile, Colombia and the Plurinational State of Bolivia; to employment in the formal sector in Brazil; to persons employed in companies in Ecuador; to direct employment in Peru; and to general employment in Mexico.

It is estimated that mining companies directly employ 50% of their workers in Chile and 66% in Peru. The rest are hired by intermediaries, and many of these workers do not enjoy all the labour rights that those hired directly by the mining companies do (COCHILCO, 2014).

More information is needed about the number and quality of the indirect jobs created by the sector. In Peru, each direct mining job creates an estimated four indirect jobs. This indicates that the sector's importance as an employer is greater than is usually recognized, but little is known about the quality of those indirectly created jobs.

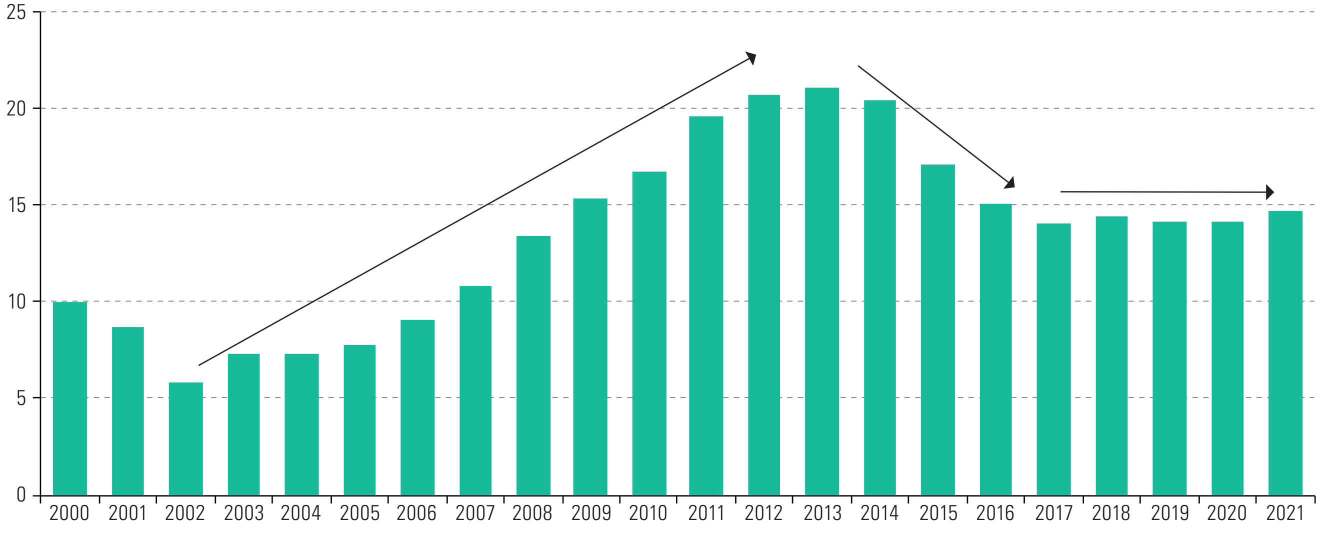
It is important to draw a distinction between artisanal and informal small-scale mining activities, although both create a large number of unskilled or low-skilled jobs for inhabitants of the rural areas where these activities are undertaken. These jobs do not, however, provide a sufficient income, may be unsafe and do not afford workers labour rights, such as contracts, a minimum wage, paid time off, social security or other benefits.

Whereas artisanal small-scale mining is based on family structures and traditional technologies that can be used alongside other production activities and that have a relatively minor impact on the environment, most informal and illegal small-scale mining activities are incompatible with traditional production activities, utilize chemical precursors that destroy fragile ecosystems and lend themselves to labour exploitation and human trafficking (Global Initiative against Transnational Organized Crime, 2016). The formalization of these mining activities remains a challenge.

The expansion of informal and illegal small-scale mining in fragile ecosystems has led to the deforestation of tropical forests and the pollution of land and watercourses. In the south-eastern Madre de Dios region of Peru, the deforestation caused by alluvial mining for gold increased by 240% between 2009 and 2017 (Quijano and others, 2020). In lode mining, which is generally conducted in more arid or mountainous areas, the main environmental impact is the pollution of watercourses caused by the chemicals that are used.

The number of mining concessions or permits that are issued is an indicator of the buoyancy of the sector. Official, comparable information for the various countries is unavailable but it is known that, in Peru, at the peak of the supercycle, mining exploration and operating concessions took in over 20% of the country's surface area (see figure VII.11). In some provinces and districts, this figure was as high as 100% or, because some concessions overlapped, even higher.

Figure VII.11
Peru: mining concessions, 2000–2021
(Percentages of the country's total area)

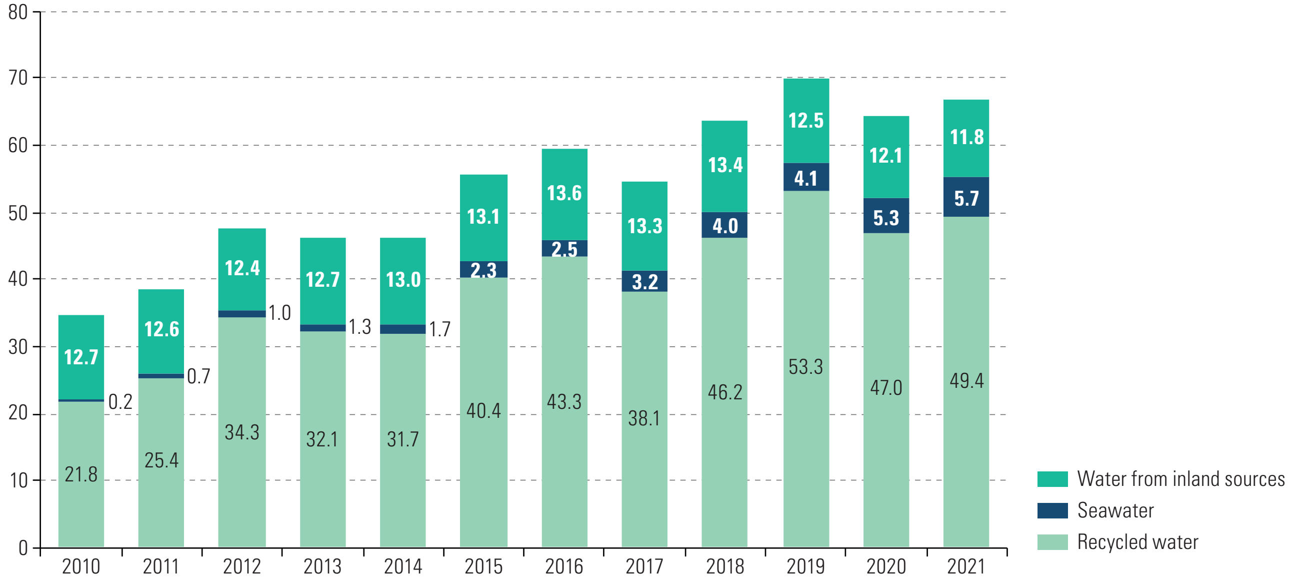


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of CooperAcción, "Mapa de concesiones mineras a nivel nacional, al mes de mayo del año 2022" [online] https://cooperaccion.org.pe/mapas/mapa-de-concesiones-mineras-a-nivel-nacional-2022/.

In each country, mining activities use a relatively small percentage of the water supply, since most of it is used for human consumption and agricultural production. Nevertheless, in basins where mining projects are located, these operations do use water for extraction and refining and for the household needs of workers, and that demand competes with other productive and household uses, especially in areas where water is in short supply. The destruction of water sources by open pit mining at the base of glaciers or in the highlands and the pollution of waterways owing to the mismanagement of tailings or other forms of environmental damage are two of the negative impacts on water resources, ecosystems and local populations that should be prevented and mitigated.

There has been a sharp increase in water recycling and the desalination of seawater in Chile, which has lessened the pressure on inland bodies of water (see figure VII.12), especially in the arid, water-starved mining regions in the north of the country. More research needs to be done, however, into the environmental impacts of desalination and the disposal of the brine that is its by-product.

Figure VII.12
Chile: water use in copper mining, 2010–2021
(Cubic meters per second)

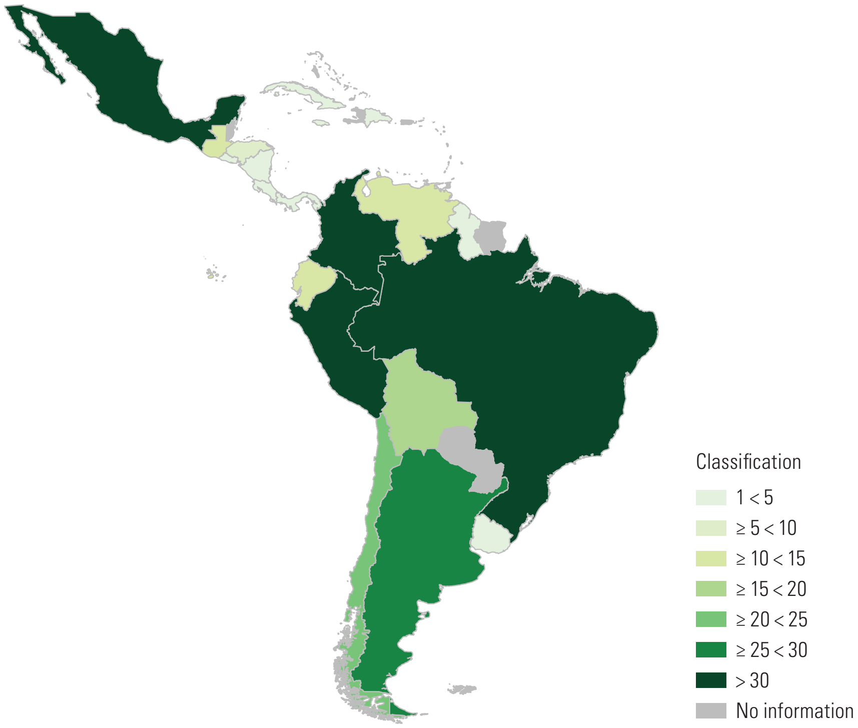


Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of V. Ramírez Jiménez and J. Cantallopts Araya, *Consumo de agua en la minería del cobre al 2019,* Chilean Copper Commission (COCHILCO), 2020.

The expansion of mining activity —and the increased pressure that it puts on the land, water resources, forests and the population groups that derive their livelihood from those resources— has sharpened social conflicts, which have also been fuelled, in many cases, by a scant State presence and a shortage of basic services, the absence or misinterpretation of consultations and of other mechanisms for the participation of the general public and of Indigenous Peoples, problems with the distribution and use of mining revenues by national and local authorities, faulty mine closure and post-closure procedures, and insufficient wages and dangerous or substandard working conditions.

No official national statistics are available of the type that would be needed to undertake a comparative analysis of the number and types of social conflicts that have arisen in connection with mining activities. Civil society reports indicate that the countries where the most mining-related conflicts have occurred are Mexico (58), Chile (49) and Peru (46), followed by Argentina (28) and Brazil (26) (OCMAL, n.d.). Map VII.3, which is based on the Global Atlas of Environmental Justice (EJAtlas), reflects the frequency of mining-related environmental conflicts that have taken place in Latin America and the Caribbean. Peru has witnessed the most such conflicts (50 cases), followed by Mexico, with 36; Colombia, with 34; Brazil, with 33; and Argentina, with 28.

Map VII.3
Latin America and the Caribbean (21 countries): mining-related environmental conflicts registered in the Global Atlas of Environmental Justice, 2022
(Cumulative number of conflicts)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Environmental Justice Atlas (EJAtlas) [online] https://ejatlas.org, L. Temper, D. del Bene and J. Martinez-Alier, "Mapping the frontiers and front lines of global environmental justice: the EJAtlas", *Journal of Political Ecology*, No. 22, 2015.

Note: In 2022, in the 21 Latin American and Caribbean countries covered in this map —Argentina, Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Guyana, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Plurinational State of Bolivia and Uruguay— reports were received of 312 environmental conflicts related to mining and the extraction of construction materials. This means that nearly half (45%) of all such disputes occurring in the world (687) were taking place in the region. Mining-related conflicts (275), in particular, represent a large share (88%) of all the environmental disputes. Data updated to 5 August 2022.

D. The outlook for mining in Latin America and the Caribbean

The world energy transition and the move towards electric vehicles will have a decisive impact on the types of minerals and metals and how much of them the region can export. Using 2020 as the base year, under the Sustainable Development Scenario for the achievement of the objectives of the Paris Agreement, world demand for lithium is projected to increase by as much as 42 times over by 2040, while demand for graphite is projected to increase by a factor of 25, for cobalt by a factor of 21, for nickel by a factor of 19 and for copper by a factor of 2.7, according to the International Energy Agency.

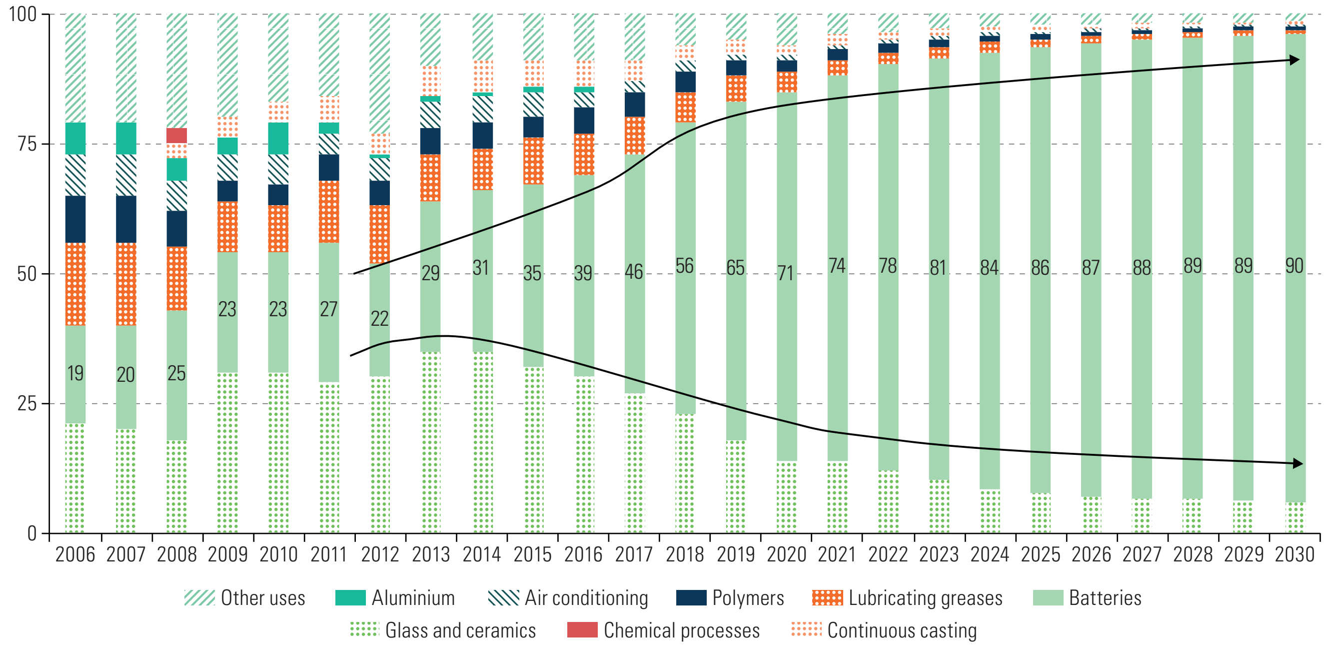
ECLAC estimates (Leañez, 2022) indicate that, based on the use of renewable sources and a regional integration scenario, Latin America will need to expand its electric power capacity by 47 gigawatts (GW) of energy from solar photovoltaic systems and 75 GW of wind-generated energy by 2032. To reach this capacity, it is forecast that generating and transmission facilities will create a demand for 611,000 tons of copper, 53,300 tons of nickel, 2,500 tons of cobalt and 2,100 tons of lithium.[1]

[1] These projections are based on the Connected Renewable Energies Scenario (CORE), which is the most optimistic one. Under this scenario, intraregional transmission is highly integrated and the penetration of renewable energy sources is high, with such sources representing as much as 80% of the energy basket in 2032.

There will be strong growth in the lithium market, in particular, in the coming years. Estimates of lithium reserves in Argentina, Chile and the Plurinational State of Bolivia, along with recently discovered reserves in Peru and Mexico, have spurred a debate about how to take advantage of this opportunity, while avoiding the policy and governance shortcomings of past years, in order to modernize the sector. Some circles have sounded a note of caution regarding the expectations around this development and have drawn attention to the potential social and environmental impacts that a new burst of mining activity could have on local populations and ecosystems if proper policies and forms of governance are not put in place (Toledano and others, 2020).

As the use of batteries to power electronic devices and electric vehicles is growing rapidly (see figure VII.13), the demand for lithium is gathering momentum, and the Andean countries are thus faced with a tremendous opportunity in terms of both mining operations and value addition.

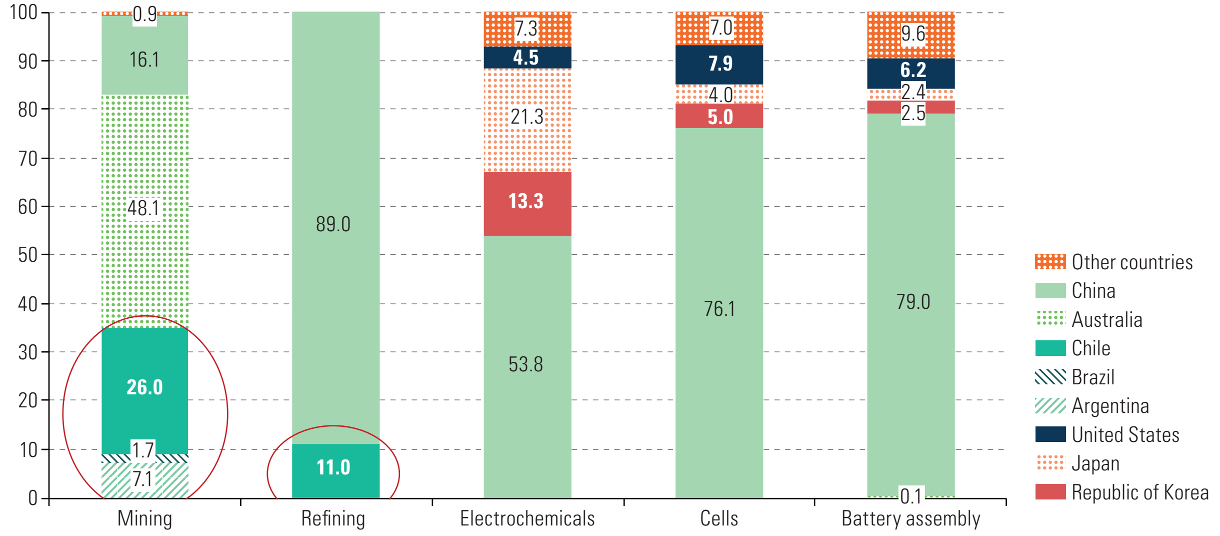
Figure VII.13
End uses of lithium worldwide, 2006–2030
(Percentages)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ECLAC, *Towards transformation of the development model in Latin America and the Caribbean: production, inclusion and sustainability* (LC/SES.39/3-P) Santiago, 2022.

The process involved in turning the lithium extracted from the ground into an automobile battery is a long and complex one, however. At present, the production linkages in the lithium battery value chain in the region are weak. Argentina, Brazil and Chile are at the very bottom of the global value chain, in the initial (extraction and concentration) and second (processing) segments (see figure VII.14).

Figure VII.14
Countries' presence in the different segments of the global lithium-ion battery value chain, 2020
(Percentages of production in each segment)



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of ECLAC, *Towards transformation of the development model in Latin America and the Caribbean: production, inclusion and sustainability* (LC/SES.39/3-P), Santiago, 2022.

E. Public policy messages to further progress towards the mining sector's transition

The transition to be made in mining is actually three transitions rolled into one: the transition of the mining industry, the transition to be made by mining countries and the transition called for in terms of regional integration.

The mining industry has to make its own transition towards a more environmentally sustainable and socially more inclusive form of mining that has a transparent, democratic and effective multi-level governance structure and that takes a locally sensitive approach focusing on the project cycle. A great deal of technological innovation will be required to boost energy and water-use efficiency, bring the industry into the circular economy, handle mining tailings appropriately and carry out environmentally sound mine closures. Environmental standards, procedures and monitoring arrangements will also have to be strengthened in order to ensure that approval is given only for mining activities that will safeguard the ecosystems in which they are located.

This new type of mining industry will also need to strengthen its consultation process with a view to obtaining the free, prior and informed consent of Indigenous Peoples, in particular, but also, more broadly, its mechanisms for consulting the public and engaging public participation at all stages of decision-making and of the projects' life cycles, starting from the issuance of mining concessions, moving on to the preparation of environmental impact assessments prior to project approval and the monitoring of projects' environmental impact during their implementation, and continuing on all the way to the management of mine closures. In order to accomplish this, mechanisms will need to be reinforced where they exist and established where they do not. This new industry will also have to make substantial improvements in terms of the economic and social impact it has on the people living in mineral-rich areas by taking action to respect their human rights (which will involve upholding gender equality, among many other rights, and working to eradicate child labour) and by adopting a strong stance in terms of corporate social responsibility, shared value, direct and indirect job creation, the formation of production linkages and the management of the fiscal resources that this activity generates.

Another essential element in creating this new kind of mining industry will be to make headway towards a form of multi-level governance that includes local, intermediate, national and international stakeholders in decision-making; that is transparent and apprises the public of the information on which decisions are based, the nature of those decisions and how they were reached; that is democratic in that it excludes no one and, on the contrary, encourages the participation of traditionally marginalized sectors, such as women, Indigenous Peoples and other rural and ethnic communities; that is effective and does not overcomplicate the decision-making process; that takes a locally sensitive approach which takes into account the interests of the inhabitants of the areas where mining is undertaken and the renewable natural resources located in those areas; and that works together with other sectors of the State that are responsible for the areas or territories in question.

As for the transition to be made by mining countries, those countries need to ensure that mining activities further the transition of their economies and societies and put them on a path that leads to the achievement of the Goals of the 2030 Agenda for Sustainable Development, with healthy ecosystems, diversified economies, cohesive societies and democratic institutions. This will entail maximizing the associated backward, forward, horizontal and fiscal production linkages, with the latter being of key importance in funding the social and productive investments that will be called for.

In order to help move these countries' transitions along, it will also be necessary to ensure that their national and local economies do not succumb to such phenomena as Dutch disease and the resulting de-industrialization and loss of competitiveness of other sectors. At the same time, steps will need to be taken to promote broad national strategies for diversifying the countries' economies and thus lessening their reliance on mining.

As for the regionalization of value chains, the transition of mining activities themselves and their role in furthering mining countries' transitions towards the achievement of the Sustainable Development Goals should be viewed within the framework of regional integration processes. These processes should be focused on the creation of regional value chains within the context of the regionalization of globalization and the establishment of shared regional fiscal, environmental and social standards and procedures that will enable the countries to negotiate from a position of greater strength —free of policies that set off a race to the bottom— regarding the conditions under which the region will take part in the new cycle of mining activity generated by population growth, the recovery of the world economy and the global energy transition.

In terms of private and public strategies for attaining the Sustainable Development Goals, mining activity in the region is confronted with the challenge of participating in the new mining cycle associated with the global energy transition, sustainable development and the post-pandemic economic landscape. These circumstances make it necessary for private companies and governments to devise new strategies. Some of the challenges to be overcome are the following.

Private companies should:

- Promote investments in technological innovation with a view to boosting competitiveness, safeguarding the health of local ecosystems (water and energy efficiency, the circular economy) and reducing GHG emissions (clean, sustainable energy sources used at the extraction, processing and transport stages).

- Strengthen strategies for working with the community and make a firm commitment to consultations with a view to obtaining free, prior and informed consent.
- Increase their contribution to government coffers by paying the appropriate taxes and royalties and putting a stop to tax evasion and avoidance.
- Become more transparent by creating specialized portals and participating in international efforts such as the Extractive Industries Transparency Initiative and the Open Government Partnership.
- Reinforce their strategies for forming backward linkages (suppliers of goods and services), horizontal linkages (technology transfer, shared use of infrastructure and services) and forward linkages (processing of ore before it is exported) in order to create and share value within the local area and the country.
- Build regional economic integration processes by participating in regional value chains.

Governments should:

- Offer services and infrastructure that benefit the population in mining projects' zones of influence and seek to buttress the mining sector's competitiveness so that its ability to compete does not hinge on the maintenance of low environmental, social and fiscal standards.
- Strengthen the environmental standards, instruments and institutions designed to safeguard the ecosystems in which mining activities are located.
- Make commitments and apply strategies for climate change mitigation and adaptation.
- Review and modify inefficient tax expenditures and establish progressive royalty schedules and taxes on earnings or rents in order to boost tax revenues from mining that can then be used to finance the investments needed to close social gaps and promote the transformation of production systems.
- Establish investment, savings and stabilization funds based on the amount of fiscal resources that are generated in order to avert Dutch disease and de-industrialization.
- Reform State-owned mining companies with a view to: maximizing rent capture; leading technological innovation forward; acquiring experience and knowledge about the sector as a means of building up regulatory capacity and thus ensuring good corporate governance while bolstering competitiveness; and broadly promoting production by small- and medium-scale mining operations and acquiring and marketing their output.
- Set up transparency portals and take part in national activities of the Extractive Industries Transparency Initiative and the Open Government Partnership to increase the mining sector's transparency and prevent corruption.
- Guarantee the public's right to participate and to exercise oversight and take steps to sign the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement).
- Reform land allocation systems and decision-making processes regarding the uses made of mining rents in order to promote the strategic utilization of these resources to close poverty and gender gaps, protect vulnerable ecosystems and promote economic diversification.

- Design locally sensitive industrialization policies to add and share value in local areas and develop sectoral and macroeconomic policies to promote the diversification and competitiveness of other sectors of the economy.
- Upgrade and carry forward policies for the formalization of mining activity and the comprehensive promotion of medium-scale, small-scale and artisanal mining.
- Promote integration processes and regional value chains based on the countries' comparative advantages so that they need not rely on highly fragile global chains.

In order for these new strategies to be effective, attention will need to be devoted to two fundamental factors. The first and more specific one has to do with what is known as the "implementation gap", that is, the gap that often exists between the standards, strategies and policies that are approved or announced by decision-makers in public and private forums, on the one hand, and, on the other, how they are put into practice. The lesson that has been learned is that, unless new standards, strategies or public and private policies are coupled with measures to strengthen the institutions tasked with implementing them and the ability of the public to monitor their implementation, then those standards, strategies and policies will have little or no effect, and little or no progress will be made in making the transition that the new state of affairs calls for.

The second, more general, factor has to do with the governance of the mining sector. If decision-making power is concentrated in one or two areas of the central government while other areas of the central government, subnational (regional, departmental or provincial) governments, local governments and the members of the population who are affected by the decisions are ignored or their participation is not sought out, then those decisions will be largely untenable, in the best of cases, or, in the worst, will give rise to resistance and conflict. This is why a polycentric (multisectoral, multilevel and multi-stakeholder) form of governance is essential if the proposed transition is to be achieved.

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Annex VII.1

Latin America (9 countries): taxation systems applying to the mining industry

Country	Ownership	Royalties (rates)	Taxes on profits (or earnings)	Other taxes on profits, gross income and payment of dividends	Other levies (tax bases)	Deductions for profit taxes	Distribution
Argentina	• Mines are owned by the entire country or one of the provinces, depending on their location. • Private mine ownership is established by legal concessions.	• Provincial governments receive royalties ranging from 0% to 3%. In Salta, Jujuy and Catamarca, royalties are calculated on the basis of the pithead value.	• Since 2021 a 25% profit tax has been levied.	• Tax on gross income: This tax varies by province and industry. In the mining provinces, such as San Juan and Salta, the rate is 0%; in Jujuy and Catamarca, the rate is 0.75%. • Withholding tax on dividends of non-resident partners: 13%. • Export duties: 4.5% free on board (FOB). • Tax on financial transactions: 0.6%.	• Redistribution of mining tax revenues (*canon minero*) collected during exploration and mining operations. • Tax burden stability: by law, mining ventures that apply and meet the legal requirements for this benefit are guaranteed that their tax burden will remain unchanged over a 30-year period.	• Amortization of exploration costs over a three-year period. • Carry-over of tax losses over a five-year period.	• Revenues are transferred to the national treasury. • Each province collects the corresponding royalties, which then become part of its budgetary resources. • There are no sovereign funds.
Plurinational State of Bolivia	• Natural resources are directly and wholly owned by the Bolivian nation in perpetuity. • Mining rights are granted by means of administrative contracts.	• Royalties of from 1% to 7%, depending on the mineral or metal concerned, are levied on the total sales value. • 60% of the corresponding royalty is applied to mineral or metal products incorporating value added.	• A 25% tax is levied on corporate profits.	• Transactions tax: 3% of gross income. • Mining surtax: 25% of net income. • Additional rate applied to windfall profits of extractive activities: 25%. • Additional rate applied to profit tax when prices are extraordinarily high: 12.5%. • Tax on profits and interest income paid out to non-resident beneficiaries: 12.5%. • Financial transactions tax: 0.3%.	• Mining licences for prospecting, exploration and mining operations.	• Amortization of specific mining obligations (mining licence fees, royalties, exploration costs and environmental remediation expenses). • Carry-over of tax losses over a five-year period.	• Mining royalty: - 85% goes to autonomous departmental governments. - 15% goes to autonomous municipal governments. - Autonomous departmental and municipal governments must allocate at least 85% of their total revenue from mining royalties to public investment projects. • Mining licence fee: - 60% goes to the Administrative Mining Authority. - 40% goes to the Geological and Mining Service (SERGEOMIN).

Country	Ownership	Royalties (rates)	Taxes on profits (or earnings)	Other taxes on profits, gross income and payment of dividends	Other levies (tax bases)	Deductions for profit taxes	Distribution
Brazil	• The Mining Act establishes that the holder of mining rights is entitled to a royalty.	• Royalties of from 1% to 3.5%, depending on the mineral or metal concerned, are levied on the pithead value.	• A 10% surtax is added to the 15% income tax rate when income exceeds 240,000 reais (or US$ 47,000) per year. In addition, a 9% social tax is charged. Thus, the total tax rate is 34%.	• There are special taxes on some types of products. • The tax rate on profits of non-residents ranges from 15% to 25%.	• Social tax on net profits: 9%. • Annual rate per hectare: 3.42 reais, rising to 5.1 reais if the period covered by a mining exploration permit is extended. • The mining resources enforcement tax varies by state and by type of mineral or metal but does not exceed US$ 3 per ton of any mineral or metal extracted. (This tax is currently charged in Amapá, Mato Grosso do Sul, Minas Gerais and Pará.)	• Amortization of exploration costs, mining licence fees and some recurring expenses. • Carry-over of tax losses; no time limit for the carry-over but it is subject to a ceiling of 30% of net annual profits.	• Distribution of royalties: - 15% goes to the states where producing mines are located.[a] - 60% goes to the municipalities where producing mines are located.[a] - 15% goes to municipalities in which no producing mines are located but which are affected by mining activity (such as municipalities through which transport infrastructure crosses or that have ports used by mining operations). - 7% goes to regulatory agencies responsible for overseeing mining activity. - 1% goes to the National Fund for Scientific and Technological Development (FNDCT). - 1.8% goes to the Mineral Technology Centre (CETEM). - 0.2% goes to the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA).
Chile	• State ownership in perpetuity of all mines is absolute, exclusive and inalienable. • Private parties may be granted ownership or full title to mining concessions. • Concessions are granted by judicial decision in non-adversarial proceedings.	• A royalty of from 0.4% to 4.4% is levied when output is more than 12,000 but less than 50,000 metric tons of fine copper. • When over 50% of sales correspond to copper or when output exceeds 50,000 metric tons of fine copper per year, the royalty has an ad valorem component of 1% on annual copper sales and an operating margin component of from 8% to 26%.	• First-category income tax: 27% (25% for small and medium-sized enterprises). • When output of fine copper is under 80,000 metric tons per year, the maximum potential tax burden is 45.5%. In all other cases, the maximum potential tax burden is 46.5%.	• Tax on profit and interest remittances: 35%. • Special tax on profits of the National Copper Corporation of Chile (CODELCO): 40%.	• Mining exploration licences: 0.1 monthly tax units (UTM) per hectare. • Mining operation licences: 0.02 UTM per hectare. • Armed Forces Tax (Copper Reserve Act): 10% of CODELCO copper export earnings are transferred to the armed forces. • Regional development tax: 1% of fixed assets. • Value added tax: 19%.	• Amortization of exploration costs over a six-year period. • Carry-over of tax losses (no time limit or annual limit).	• The law on mining royalties establishes that resources are to be distributed among a number of different funds, some of which are temporary: - Regional Productivity and Development Fund. - Mining Communes Fund (32 municipalities). - Territorial Equity Support Fund (302 communes). - Regional and Municipal Bridging Support Fund for 2024 (northern regions). - Multi-Year Citizen Security Fund (northern regions). - Tri-Annual Resource Fund (for leveraging productive infrastructure investment projects in the northern regions of the country).

Country	Ownership	Royalties (rates)	Taxes on profits (or earnings)	Other taxes on profits, gross income and payment of dividends	Other levies (tax bases)	Deductions for profit taxes	Distribution
Colombia	• The State owns the subsoil and non-renewable natural resources without prejudice to acquired and perfected rights as provided for under pre-existing laws. • Mining concession contracts may be granted.	• Royalties range from 1% to 12% of the pithead value, depending on the mineral or metal concerned. • An additional 4% royalty is applied to gold, silver and platinum; those receipts to go the municipalities where producing mines are located.	• Corporate tax: 32%. • Profit tax: - 30% (2022). - 20% in free trade zones.	• Tax on dividends paid out to non-residents: 10%. • Tax on interest earnings of non-residents: 20%. • Financial transaction tax: 0.4%.	• Land-use fee (*canon superficiario*) charged per hectare during the exploration, construction and set-up stages.	• Amortization of exploration costs over a maximum period of five years and of recurring expenses incurred in the course of mining activity. • 50% deduction on financial transactions tax. • Carry-over of net losses over the following 12 fiscal years.	• Distribution by the General Royalties System (SGR): - Direct allocation: 20% to departments and municipalities where producing mines are located. - Allocation for local investment: 15% for the poorest municipalities. - Allocation for regional investment: 34% for regional investment projects. - Environmental allocation: 1% for environmental conservation and measures to combat deforestation. - Allocation for science, technology and innovation: 10% for investment in these areas. - Corporación Autónoma Regional del Río Grande de la Magdalena: 0.5% for investment projects in riparian municipalities. - SGR operations: 2%. - SGR monitoring and inspection operations: 1%. - Saving and Stabilization Fund: 8.25%. - National Pensions Fund of Territorial Entities: 8.25%.
Dominican Republic	• All mineral substances belong to the State. • Concessions or contracts may be granted.	• Royalties of 5% on the FOB value are levied. • 0.10 Dominican pesos are received for every cubic meter of non-metallic mineral that is mined.	• Tax on profits and earnings in the country: 27%.	• Tax on dividends and interest earnings of non-residents: 10%.	• Licence fees charged to concession holders: between 0.10 and 2 Dominican pesos per hectare. • Single use environmental charge: 4 Dominican pesos per cubic meter.	• Carry-over of tax losses over a five-year period, with a ceiling of 20% of annual profits.	• The proceeds are used to further the nation's development and are allocated to the provinces and municipalities where producing mines are located through various distributive mechanisms and development funds based on the nature of each licence.
Ecuador	• Non-renewable natural resources are the inalienable property of the State in perpetuity. • Concessions, exploration licences, operating contracts and service contracts may be granted.	• Metals and metal products: royalties of between 3% and 8% are levied, depending on the volume of output and type of mineral. • Non-metallic products: royalties are between 10% and 100% of production costs, depending on the size of the producer and the volume of output.	• Profit tax: 25%.	• Sovereign margin (minimum mining rent for the State): 50%. • Tax on dividends paid out to non-residents: 10%. • Tax on interest earnings of non-residents: 25%.	• Conservation fee: between 2.5% and 10% of the Unified Basic Salary (SBU) per hectare of the concession area for medium-scale and large-scale mining operations; the fee is 2% for small-scale mining ventures. • Labour tax: 15% of gross profits.	• Labour participation tax. • Royalties of up to 1% of the tax base. • Carry-over of tax losses over a five-year period subject to a ceiling of 25% of annual profits.	• Most of the revenue is transferred to the national treasury. • 60% of the royalties and 12% of the labour participation tax receipts are used for social investment projects undertaken by the national government or autonomous decentralized governments. • Fiscal Stabilization Fund (2018): based on the surplus budgeted income from non-renewable natural resources.

Country	Ownership	Royalties (rates)	Taxes on profits (or earnings)	Other taxes on profits, gross income and payment of dividends	Other levies (tax bases)	Deductions for profit taxes	Distribution
Mexico	• All natural resources are directly owned by the nation (article 27 of the Constitution). Mining concessions may be granted.	• Mining duties: from 0.5% to 7.5% of gross income, depending on the age of the mine.	• Income tax: 30%.	• Withholding tax on profits: 10%. Withholding tax on interest: 35% to 40%.	• Special duty: 7.5%. Special duty on gross income from sales of gold, silver and platinum: 0.5%. Additional duty on unexplored or non-producing concessions. Discovery premiums (percentage of invoiced value). • Value added tax: 16%.	• Amortization of pre-operations and exploration expenses at an annual rate of 10%. • Carry-over of tax losses over the following 10 years.	• Mining duties are distributed as follows: - Federal government: 20%. - Fund for Sustainable Regional Development of Mining States and Municipalities: 80% (62.5% for Federal District municipalities and districts and 37.5% for the state in which minerals or metals have been extracted). • Discovery premiums are paid to the Mexican Geological Service.
Peru	• Non-renewable natural resources belong to the nation. The State has sovereign rights over their development. • Mining concessions may be granted.	• Royalties of between 1% and 12% are levied on operating profits of producers of metallic and non-metallic minerals.	• Income tax: 29.5%.	• Tax on dividends and distributed profits: 5%. • Tax on interest earnings: 4.99% or 30%.	• Special mining tax: 2%–8.4% on the operating margin. • Special levy on metal mining: 4%–13.12% on the operating margin, less the mining royalty (for companies that have tax stability contracts). • Annual mining fee (*derecho de vigencia*): - General regime: US$ 3 per hectare. - Small-scale mining ventures: US$ 1 per hectare. - Artisanal mining: US$ 0.5 per hectare. • General sales tax: 18%. • Distribution of profits to workers: 8%. • Financial transactions tax: 0.005%.	• Amortization of exploration and recurring expenses (financial transactions, mining royalties, profits distributed to workers). • Carry-over of tax losses against net profits over the following four years or against 50% of net profits, with no time limit.	• Redistribution of mining tax revenue (*canon minero*): 50% of income tax receipts are transferred to subnational governments in the regions where mines are located. • Mining royalty: 95% goes to subnational governments and 5% goes to universities in the regions where mines are located. • The special mining levy is paid into the national treasury. • Annual mining fee (*derecho de vigencia*): 75% goes to local and departmental governments, 10% to the Geological, Mining and Metallurgical Institute, 10% to the National Concessions and Zoning Institute and 5% to the Ministry of Energy and Mines. • The Tax Stabilization Fund receives a percentage of the proceeds from the sale of assets carried out as part of privatizations and concession processes, along with a percentage of the budgetary balance of the national treasury when mineral price supercycles occur.

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official information.
Note: The information corresponds to the latest year available in official databases.
[a] Of the funds distributed to states and municipalities, 20% must be used for measures designed to promote economic diversification.

This document offers an analysis of the natural resources situation in Latin America and the Caribbean, with a view to promoting discussions on the role those resources can play in the transition to a development model that is sustainable.

Natural resources, both renewable and non-renewable, are crucial to the economic development of the region. Latin America and the Caribbean contains almost 20% of the world's oil reserves, at least 25% of some strategic metals and over 30% of the world's virgin forest area. In the region, natural resource-based economic activities account for 12% of value added, 16% of employment and 50% of exports. There are benefits to their use, but also harmful effects, including the potential to cause socioenvironmental conflicts.

In view of the ongoing cascading crises and the need to meet the Goals of the 2030 Agenda for Sustainable Development, it is vital to consider how natural resources can contribute to economic recovery and a development model that takes into account the principles of sustainability and equity. Natural resources such as water and energy have the potential to create new industries and improve communities' well-being, making them key transformative factors for sustainable development.

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