The economics of climate change in Latin America and the Caribbean, 2023

Financing needs and policy tools for the transition to low-carbon and climate-resilient economies

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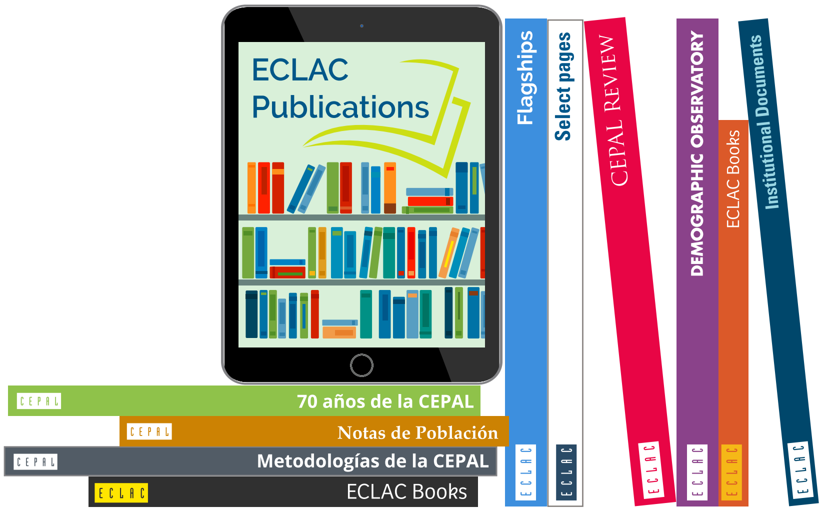

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Foreword

Climate change is, in all likelihood, the greatest generational challenge of our time. For years, the Economic Commission for Latin America and the Caribbean (ECLAC) has been analysing its impacts in Latin America and the Caribbean and has found that the cost of inaction outweighs the cost of action, that these impacts are non-linear, increasing exponentially with the rise in temperature, and that global warming will exacerbate the negative effects of extreme weather events.

Such events are known to severely affect energy, water and food systems, among others, triggering disruptions in human activities, deepening inequalities and fuelling migration. Far-reaching structural change is needed to effect the shift to carbon-neutral economies and, in view of the existing and projected level of warming, adaptation measures must be implemented without delay.

While the transition to carbon-neutral and climate-resilient societies is complex and poses an urgent challenge, it is also an opportunity for the region. Investment in climate action can yield not only environmental, but also economic and social gains, as the levels of investment and financing for mitigation and adaptation measures will provide a major boost to growth, employment and social development, which are essential in a region in the throes of low growth, low job creation and low investment.

As this document shows, Latin America and the Caribbean is deeply committed to climate action, having set the target of a reduction in emissions by 2030 of between 24% and 29% with respect to a business-as-usual scenario. To achieve this, the region's decarbonization rate would have to be four to five times faster than its historical rate. Progress towards this goal will require the development of comprehensive strategies that include not only the energy sector, but also the transport and agrifood sectors. It will also require tackling deforestation and waste management, among other issues, and influencing countries' spending and investment priorities.

This document summarizes the amount of resources needed to achieve the nationally determined contributions (NDCs) in Latin America and the Caribbean. Because it is an aggregate exercise, it does not cover all aspects of quantification, nor does it include all sectors identified by the countries or all possible associated costs for each sector. However, the analysis successfully reflects the scale of the challenge amid insufficient investment and a scarcity of concessionary funds reaching the region. It also highlights the need to coordinate policies and align the financial system in order to channel investment flows towards productive activities that boost the sectors that drive the economy with a view to achieving development that is more productive, more inclusive and more sustainable.

The financing needs that have been identified presuppose the availability of substantial, but not unattainable, amounts; and the time to act is now. All stakeholders —the public, private and social sectors— must work together to create enabling frameworks and promote appropriate projects. ECLAC remains committed to and will continue working for an environmentally sustainable, socially inclusive and economically competitive future in Latin America and the Caribbean.

José Manuel Salazar-Xirinachs

Executive Secretary

Economic Commission for Latin America and the Caribbean (ECLAC)

Introduction

Climate change is increasingly evident worldwide and its effects are harming people, societies, economies and ecosystems. Latin America and the Caribbean is no exception, and droughts, forest fires and extreme storms in the region are growing in frequency and intensity. This is all occurring amid the backdrop of low growth in the region, which is reflected in a decade of stagnation, and the effects of the pandemic and armed conflicts, which together jeopardize the progress made thus far in terms of development and, above all, limit countries' ability to improve the well-being of their populations in a sustainable manner.

However, it is in this period of "cascading crises" that climate action offers an opportunity to boost growth and innovation, create jobs and to better integrate countries of the region into the global economy. The region has shown a strong commitment to addressing climate change, and the investments, plans and policies required to tackle the climate crisis may also help to achieve economic and social goals.

This document presents some basic data on the signs of climate change and overall economic impacts, emission trends and regional commitments to reduce emissions. It also outlines climate investment needs by sector. Lastly, it presents policies and key transformative sectors for climate action.

Chapter I

Climate change: urgent action is required

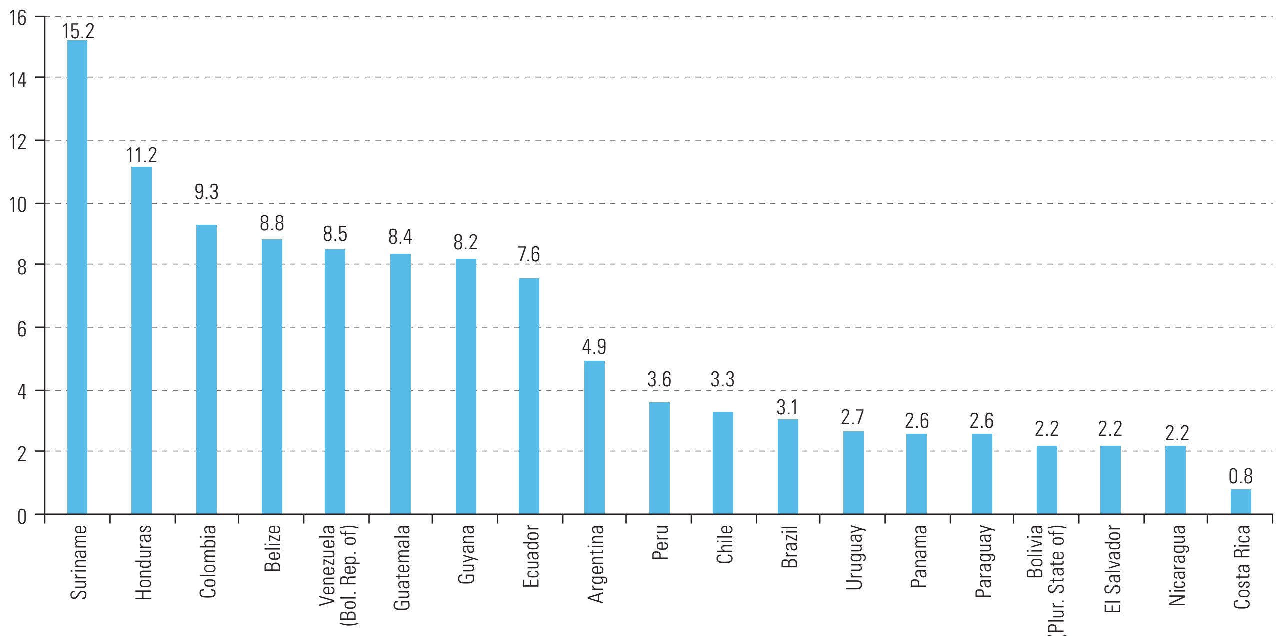
A. Climate trends and economic impacts
B. Effects of temperature on productivity
C. Carbon budget and nationally determined contributions
D. Overview of emissions in Latin America
E. Nationally determined contributions in Latin America and the Caribbean
F. Climate action and structural change

A. Climate trends and economic impacts

Climate change is increasingly evident: in 2023, the summer season in the northern hemisphere (June, July and August) was the warmest on record, 0.66°C above the 1991–2020 average. The latest report of the Intergovernmental Panel on Climate Change (IPCC) leaves no doubt about the impact of human activities on the climate system. From 2011 to 2020, the average land surface temperature was 1.1°C higher than in 1850–1900; increases were greater over land (1.6°C) than over the ocean (0.9°C) (IPCC, 2021). One of the main findings of the 2021 scientific report is that, owing to the inertia of the climate system, regardless of measures taken to reduce emissions in the near future, the average temperature is expected to increase by 1.5°C compared to the pre-industrial period by the middle of the twenty-first century. If the pace of deep decarbonization is not stepped up, the 2°C threshold is likely to be exceeded by mid-century, with an increase of up to 4°C compared to pre-industrial levels by 2100 (IPCC, 2021).

In Latin America and the Caribbean, the temperature has increased by between 0.7°C and 1°C with respect to the 1961–1980 average (WMO, 2023). The days of exposure to heatwaves have increased (see figure 1), weighing on productivity and growth (IPCC, 2022a; Alatorre and Fernández, 2022). The region has seen glaciers in the tropical Andes lose at least 30% of their surface area since 1980, affecting ecosystems, water availability, and soil quality and erosion rates, as well as an increase in flooding and landslides. It has also seen extraordinary drought episodes: the drought in central Chile is probably the longest and most severe in at least 1000 years; the drought in the Paraná-La Plata Basin is considered the worst since 1944; and more than 50% of Mexico has been affected by severe to exceptional drought (WMO, 2023). Coral reefs are decreasing in abundance, density and cover and seeing an increase in bleaching (IPCC, 2022a), which affects coral-supported ecosystems. The region has also experienced an increase in forest fires and the spread of vector-borne diseases (IPCC, 2022a; WMO, 2023).

Figure 1
Latin America and the Caribbean (19 countries): number of additional days of exposure to heatwaves in 2016–2020 compared to 1986–2005



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Working Group II Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, H. Pörtner and others (eds.), Cambridge, Cambridge University Press, 2022.

In addition, climate change is projected to exacerbate eight key risks in the region (IPCC, 2022a):

(i) Risk of food insecurity owing to more frequent or extreme droughts.

(ii) Risk to life and infrastructure owing to flooding and landslides.

(iii) Risk of water insecurity.

(iv) Risk of severe health impacts owing to increasing epidemics, particularly vector-borne diseases.

(v) Systemic risks of surpassing infrastructure and public service systems.

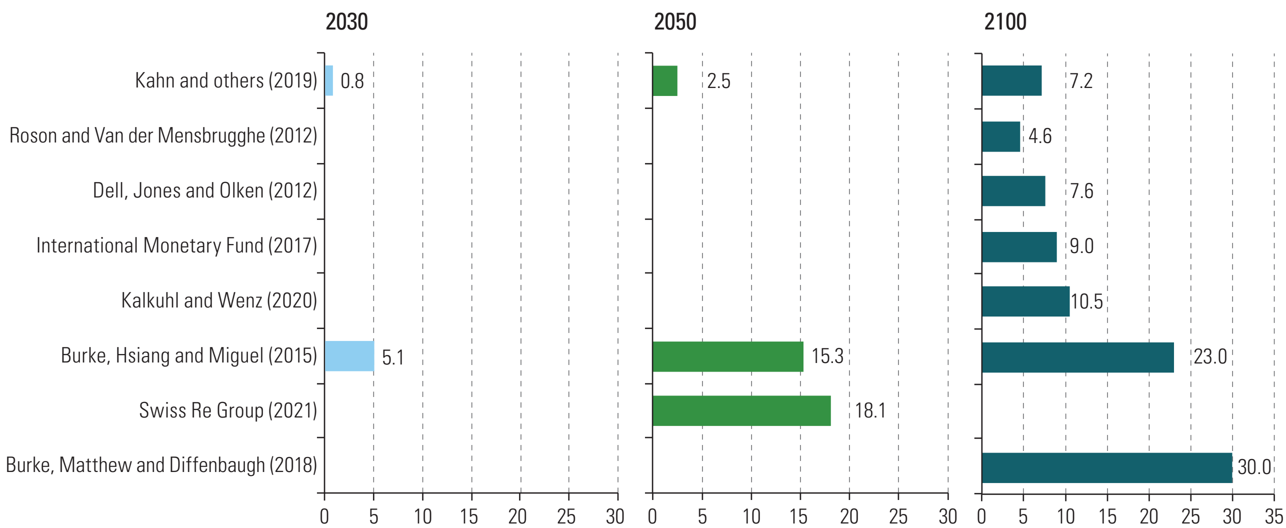
(vi) Risk of large-scale changes and biome shifts in the Amazon.

(vii) Risk to ecosystems associated with coral reefs, owing to coral bleaching.

(viii) Risks to socioecological systems in coastal areas owing to sea level rise, storm surges and coastal erosion.

Changes in the climate system have negative effects on economic activities, ecosystems and human well-being.[1] There are several recent estimates of the global economic impact of climate change (see figure 2). These estimates, which differ in terms of scope, methodology and time horizon, show that the impact of climate change on per capita GDP would range from 4.6% to 30% by 2100, under a high-emissions scenario. Estimates for 2030 already show a loss of between 0.8% and 5% of per capita GDP (Alatorre and Fernández, 2022).

Figure 2
World: impact of climate change on per capita GDP (Representative Concentration Pathway (RCP) 8.5)
(Percentages of per capita GDP without climate change)



Source: Prepared by the authors, on the basis of M. Burke, S. Hsiang and E. Miguel, "Global non-linear effect of temperature on economic production", *Nature*, No. 527, Berlin, Springer, 2015; M. Burke, W. Matthew and N. Diffenbaugh, "Large potential reduction in economic damages under UN mitigation targets", *Nature*, No. 557, Berlin, Springer, 2018; International Monetary Fund (IMF), *World Economic Outlook October 2017. Seeking Sustainable Growth: Short-Term Recovery, Long-Term Challenges*, Washington, D.C., 2017; M. Dell, M., B. Jones and B. Olken, "Temperature shocks and economic growth: evidence from the last half century", *American Economic Journal: Macroeconomics*, vol. 4, No. 3, Nashville, American Economic Association (AEA), 2012; M. Kahn and others, "Long-term macroeconomic effects of climate change: a cross-country analysis", *NBER Working Papers*, No. 26167, Cambridge, National Bureau of Economic Research (NBER), 2019; Swiss Re Group, Annual Report 2021, Zurich, 2021; R. Roson and D. Van der Mensbrugghe, "Climate change and economic growth: impacts and interactions", *International Journal of Sustainable Economy*, vol. 4, No. 3, Geneva, Inderscience Enterprises, 2012; M. Kalkuhl and L. Wenz, "The impact of climate conditions on economic production: evidence from a global panel of regions", *Journal of Environmental Economics and Management*, vol. 103, Amsterdam, Elsevier, 2020.

Note: Burke, Matthew and Diffenbaugh (2018), Burke, Hsiang and Miguel (2015), IMF (2017), Dell, Jones and Olken (2012) and Khan and others (2019) estimate impacts on per capita GDP; Swiss Re Group (2021), Roson and Van der Mensbrugghe (2012) and Kalkuhl and Wenz (2020) estimate impacts on GDP. The report of Swiss Re Group (2021) considers the estimate for RCP8.5 multiplied by 10; for Kalkuhl & Wenz (2020), the mean of the impact for the 7%–14% range is shown. For IMF (2017), the impact factors in only low-income countries.

[1] See Alatorre and Fernández (2022) for a brief literature review for the region.

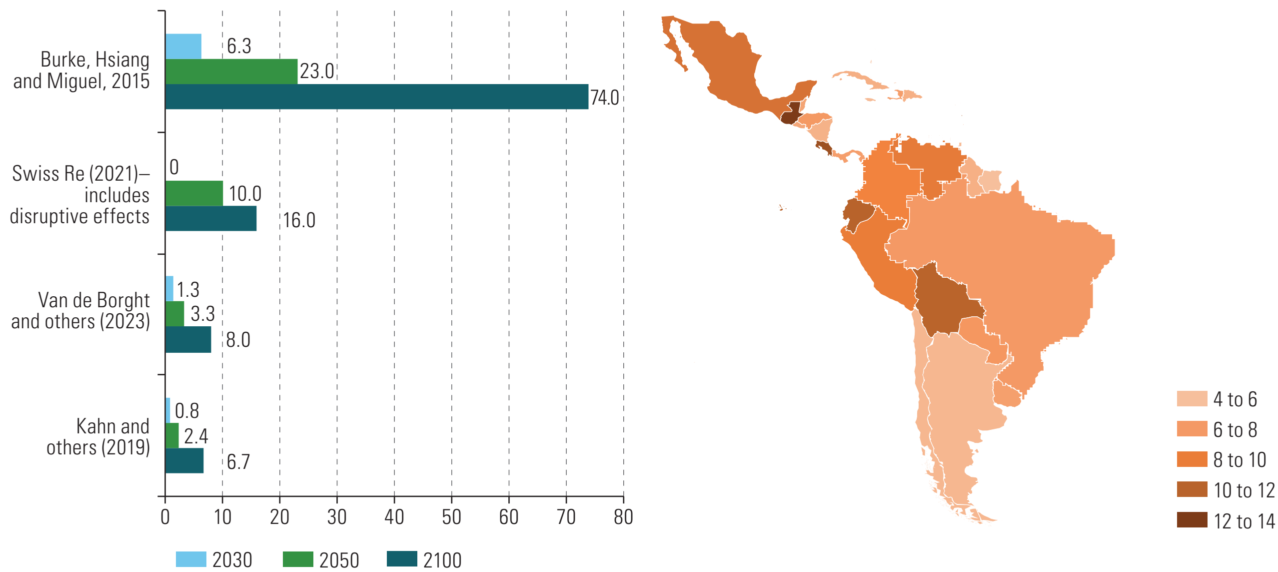
Estimates for Latin America and the Caribbean show that, depending on the study, the decline in per capita GDP would be between 0.8% and 6.3% by 2030, and up to 23% in 2050 (see figure 3). Van Der Borght and others (2023) estimate that factoring in temperature increase alone already indicates lasting negative effects on economic growth. In a high-emissions scenario this would lead to a reduction of 1.3% and 3.3% in per capita GDP in 2030 and 2050, respectively, relative to a scenario with no temperature increase (Van Der Borght and others, 2023), which could result in a 3.2 million increase in people living in poverty (ECLAC, 2022a). To this calculation must be added the effects of extreme weather events such as droughts, storms and hurricanes or price shocks linked to disorganized transitions in the energy, transport and food markets. The impact among countries is mixed (see figure 3).[2]

Figure 3

Latin America and the Caribbean: impact of climate change on per capita GDP (RCP 8.5)

A. Per capita GDP losses, 2030, 2050, 2100
(Percentages of per capita GDP without climate change)

B. Per capita GDP losses, 2100
(Percentages of per capita GDP without climate change)



Source: Prepared by the authors, on the basis of M. Burke, S. Hsiang and E. Miguel, "Global non-linear effect of temperature on economic production", *Nature*, No. 527, Berlin, Springer, 2015; M. Kahn and others, "Long-term macroeconomic effects of climate change: a cross-country analysis", *NBER Working Papers*, No. 26167, Cambridge, National Bureau of Economic Research (NBER), 2019; Swiss Re Group, *Annual Report 2021*, Zurich, 2021; R. Van der Borght and others, "Los efectos del cambio climático en la actividad económica de América Latina y el Caribe: una perspectiva empírica", *Project Documents* (LC/TS.2023/83) Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2023.

Note: Burke, Hsiang and Miguel (2015) and Khan and others (2019) estimate impacts on per capita GDP; Swiss Re Group (2021) estimates impacts on GDP and considers the estimate for RCP8.5 multiplied by 10, which includes disruptive events, based on increases of 2°C in 2050 and 3.2°C in 2100.

Taking into account the worsening of acute climate shocks by 2050, recent estimates for six highly exposed countries in the region show that GDP could be between 9% and 12% lower than that corresponding to a trend growth scenario. This would require exceptionally large additional investments to offset such impacts (ECLAC, 2023a).

[2] Comprehensive studies on the impacts of climate change at the national level were developed within the framework of regional economic studies on climate change, a Latin American and Caribbean initiative led by ECLAC, which maintains the same technical and organizational guidelines in the countries that are part of the process. This initiative has been supported by: the Governments of Denmark, Germany, Spain and the United Kingdom; the Inter-American Development Bank (IDB); the European Union; and the United Nations Development Account. A key tool for generating data on the impacts of the rise in mean sea level is the Regional study on the effects of climate change on the coasts of Latin America and the Caribbean, which was prepared by ECLAC, the Spanish Office for Climate Change —of the Ministry for Ecological Transition and Demographic Challenge of the Government of Spain— and the Institute of Environmental Hydraulics of the University of Cantabria.

B. Effects of temperature on productivity

There is evidence on the effects of heat stress at the microeconomic and macroeconomic levels. High temperatures affect not only physical production, but also mental productivity, including cognition and learning (Lai and others, 2023). For example, in the United States, it is estimated that on days when temperatures rise above 25°C, the average loss of productivity is around 2% for each additional degree of temperature, and reflects non-linear behaviour (Seppänen, Fisk and Lei-Gomez, 2006). It has been estimated that the optimal temperature range for task performance is between 18°C and 22°C; deviations above or below this range significantly affect labour productivity (Heal and Park, 2016). One study indicates that acute heat stress conditions of 40°C can reduce physical work capacity by up to 78% (Foster and others, 2021).

With regard to sectors, in the United States, the evidence shows that the impacts are greater for labour-intensive sectors, with industry showing more losses than agriculture, as high temperatures increase work absenteeism (Lai and others, 2023). Evidence for the United States automotive industry suggests that in a week when temperatures rise above 32°C for more than five days, weekly production is reduced by 8% (Cachon, Gallino and Olivares, 2012). There is also evidence for other countries; in India, each additional degree above 22°C reduced labour productivity in a call centre by 1.8% (Niemelä and others, 2002).

These impacts on productivity over time, and independently of other climate change impacts on the economy —such as soil losses and losses related to acute extreme events— directly affect economic growth rates and may weigh on them permanently (Cachon, Gallino and Olivares, 2012; Heal and Park, 2016). In the United States, temperature increases diminished growth rates by 1.7% in 1960–2011 (Deryugina and Hsiang, 2014). A global study shows that warmer years are associated with lower growth rates in the poorest countries (Dell, Jones and Olken, 2012). However, more recent papers show that temperature increases will negatively affect all countries, regardless of income level (Burke, Hsiang and Miguel, 2015; Kahn and others, 2019). For Latin America and the Caribbean, an additional 1°C translates into a loss of 1 percentage point in per capita growth (Van der Borght and others, 2023).

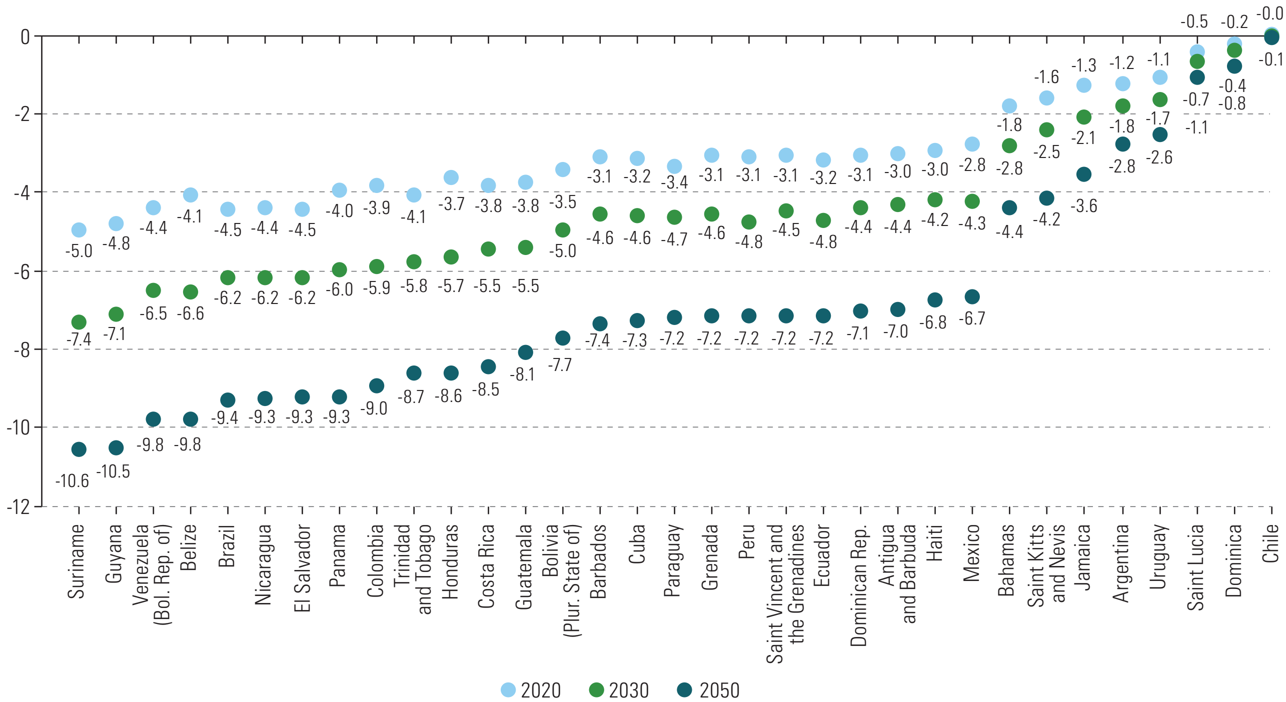
Given the evidence, climate change is affecting long-term economic performance and will have an even bigger impact if emission reduction targets are not met. Several countries in Latin America and the Caribbean have already experienced numerous days above 35°C, and these are expected to increase sharply under Shared Socioeconomic Pathway scenarios, including SSP2-4.5 (current policies) and SSP5-8.5 (very high) emissions scenarios. In South America, temperatures are expected to rise above 35°C for 12%–16% of the days of the year, on average, by mid-century, and for 15%–26% days by the end of the century (see table 1). This would have an impact on productivity and, therefore, long-term economic performance (see figure 4).

Table 1
World, North America, South America: projected number of hot days with temperatures over 35°C

Region	Period	Scenario	Median *(days)*
World	Near term (2021–2040)	Current policies (SSP2–4.5)	14.3
		High emissions (SSP5–8.5)	14.6
	Medium term (2041–2060)	Current policies (SSP2–4.5)	16.1
		High emissions (SSP5–8.5)	17.4
	Long term (2081–2100)	Current policies (SSP2–4.5)	18.6
		High emissions (SSP5–8.5)	26.4
North America	Near term (2021–2040)	Current policies (SSP2–4.5)	7.8
		High emissions (SSP5–8.5)	7.5
	Medium term (2041–2060)	Current policies (SSP2–4.5)	9.2
		High emissions (SSP5–8.5)	9.9
	Long term (2081–2100)	Current policies (SSP2–4.5)	10.8
		High emissions (SSP5–8.5)	17.6
South America	Near term (2021–2040)	Current policies (SSP2–4.5)	36.9
		High emissions (SSP5–8.5)	43.7
	Medium term (2041–2060)	Current policies (SSP2–4.5)	44.9
		High emissions (SSP5–8.5)	57.1
	Long term (2081–2100)	Current policies (SSP2–4.5)	54.6
		High emissions (SSP5–8.5)	95.6

Source: Intergovernmental Panel on Climate Change (IPCC), IPCC WGI Interactive Atlas [online database] https://interactive-atlas.ipcc.ch.

Figure 4
Latin America and the Caribbean (33 countries): relative change in labour productivity owing to heat stress compared to the 1986–2006 reference period, based on current Network for Greening the Financial System (NGFS) scenarios for 2020, 2030 and 2050
(Percentage points)



Source: Prepared by the authors, on the basis of Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) [online] https://www.isimip.org/; Climate Analytics, Climate Impact Explorer [online] https://climate-impact-explorer.climateanalytics.org/.

Note: The impact of heat stress on labour productivity in figure 4 is presented as the percentage decrease in efficiency during usual working hours in hot and humid weather conditions, owing to the reduced capacity of the human body to perform physical work. Projections weighted by population or GDP are calculated assuming that both the size and distribution of these two parameters would remain constant as from 2005. The Climate Impact Explorer shows climate impacts on biophysical systems, extreme events and the resulting economic damages for the various NGFS scenarios that have been developed to provide a common baseline for analysing climate risks to the economy and financial system. Our analysis is based on the current policies NGFS scenario which assumes that only currently implemented policies are preserved, which will lead to global warming of more than 3°C by 2100 and associated high climate impacts. The values presented in the charts are the relative changes in labour productivity, expressed in percentage points, compared to the 1986–2006 reference period, according to the NGFS current policies scenario for 2020, 2030 and 2050.

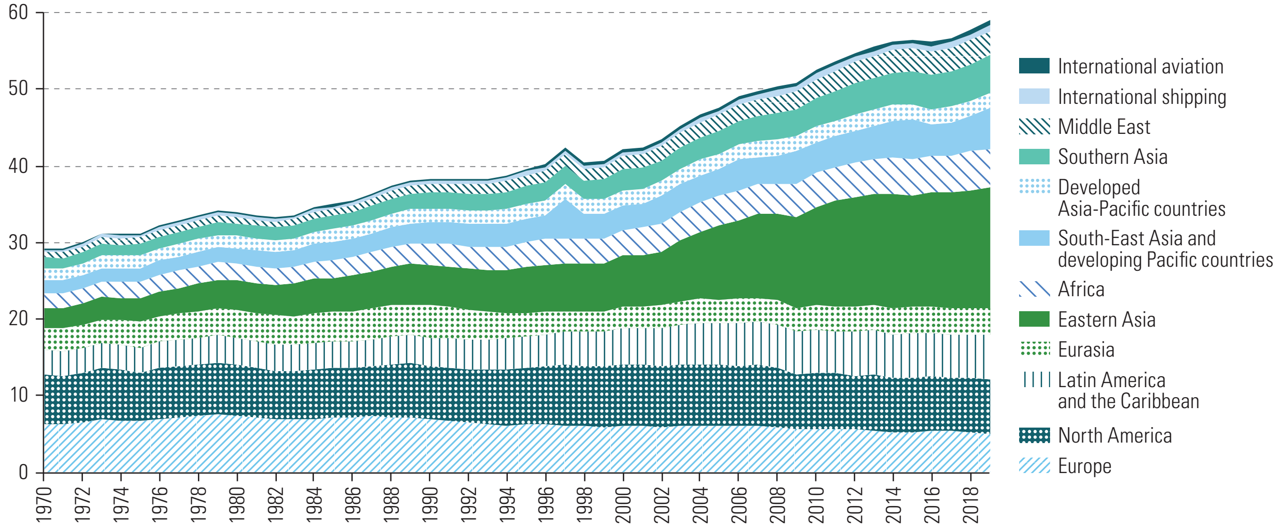
C. Carbon budget and nationally determined contributions

Achieving the Paris Agreement goal to keep the temperature increase below 2°C and ideally at 1.5°C above pre-industrial levels would forestall the most damaging impacts of climate change, but requires immediate and significant reductions in greenhouse gas emissions.

In 2019, annual emissions had reached 60 $GtCO_2eq$, 12% higher than the 2010 level (see figure 5) (IPCC, 2022b).

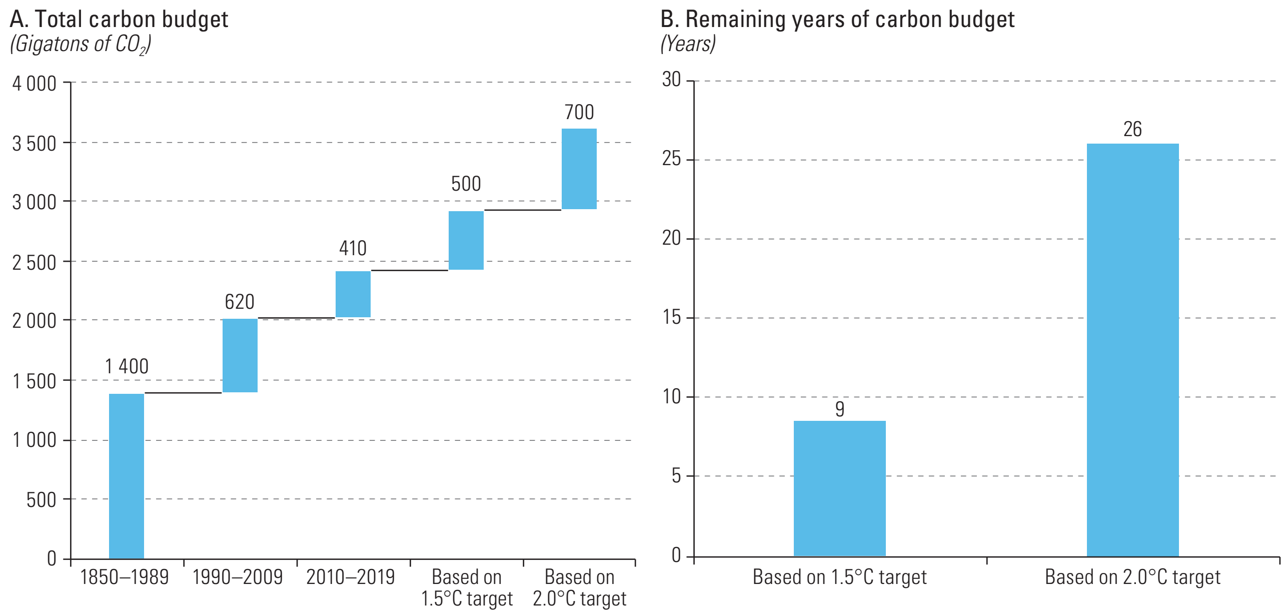
The carbon budget is the maximum amount of cumulative anthropogenic carbon dioxide (CO_2) emissions that result in limiting global warming to a given level with a given probability (IPCC, 2022b). If the amount of annual emissions remains unchanged, the carbon budget to maintain the 1.5°C target would be exhausted in 9 years, while the carbon budget to maintain the 2°C target would be exhausted in 26 years (see figure 6.B).

Figure 5
World: greenhouse gas emissions, 1970–2019
(Gigatons of CO_2 equivalent)



Source: Prepared by the authors, on the basis of J. Minx and others, "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019", *Earth System Science Data*, vol. 13, No. 11, Göttingen, Copernicus Publications, 2021.

Figure 6
World: carbon budget by temperature target



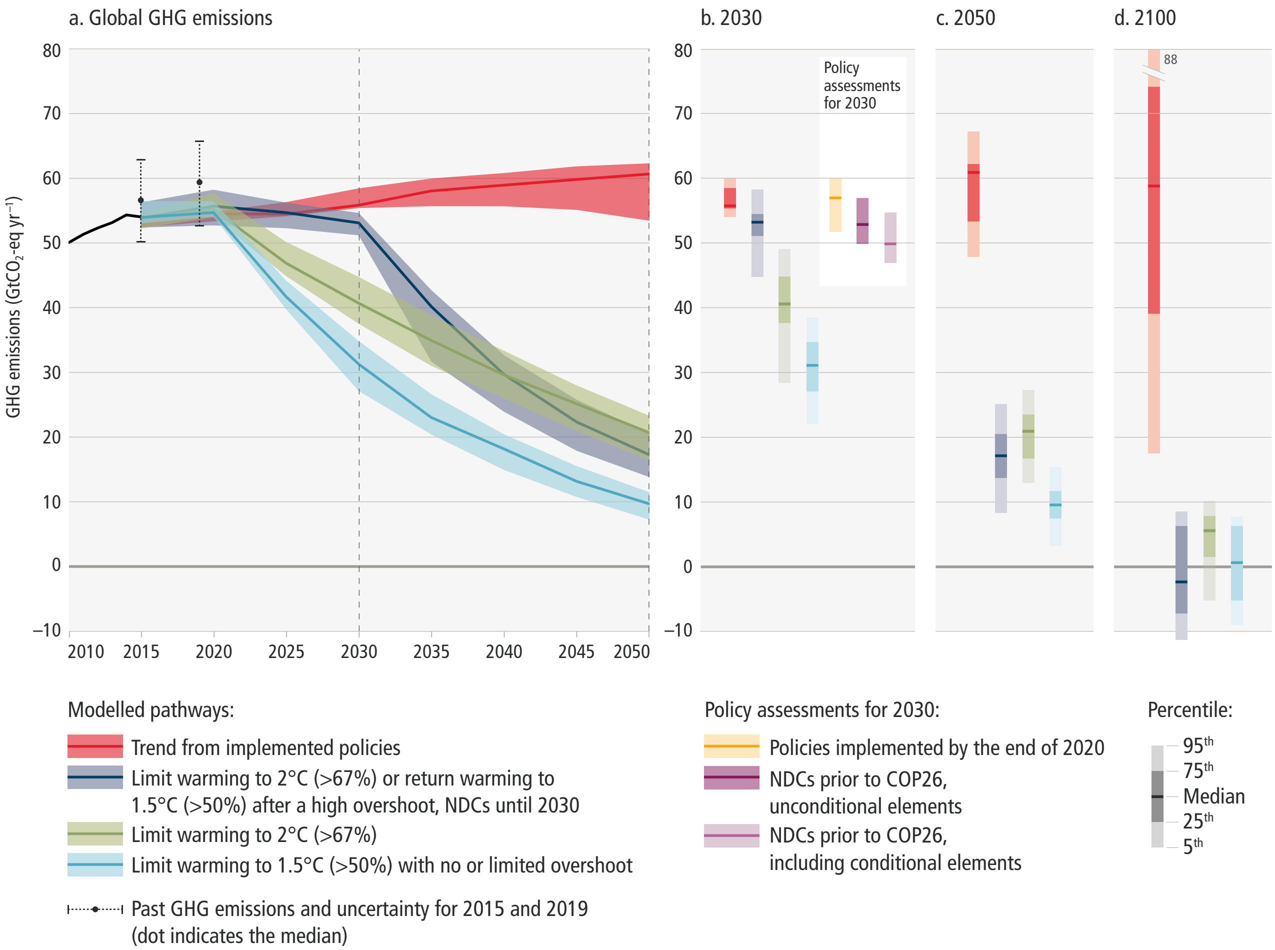
Source: Prepared by the authors, on the basis of Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Mitigation of Climate Change. Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, P. Shukla and others (eds.), Cambridge, Cambridge University Press, 2022.

Note: The carbon budget is calculated taking into account 68% probability of maintaining the temperature increase below the level specified in the figure.

Respecting the carbon budget consistent with the 2°C target requires a reduction, by 2030, of 29% relative to a scenario in which emissions follow their historical trend (see infographic 1), while the 1.5°C target requires a 45% reduction (IPCC, 2022b).

Infographic 1
World: greenhouse-gas emissions of modelled pathways and projected emission outcomes from near-term policy assessments for 2030
(Gigatons of CO_2 equivalent)

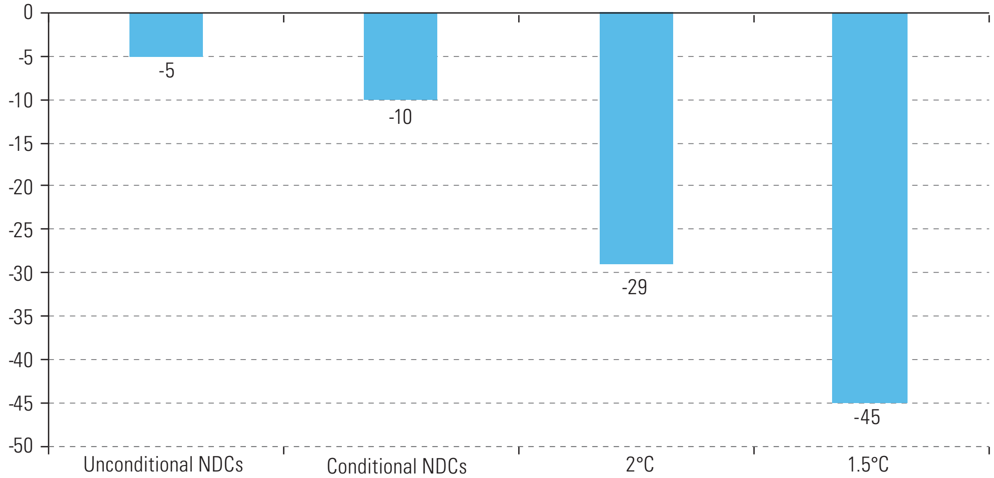
Projected global GHG emissions from NDCs announced prior to COP26 would make it likely that warming will exceed 1.5°C and also make it harder after 2030 to limit warming to below 2°C.



Source: Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2022: Mitigation of Climate Change. Working Group III Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, P. Shukla and others (eds.), Cambridge, Cambridge University Press, 2022.

However, the sum of national reduction commitments, as expressed in nationally determined contributions (NDCs), falls far short of the reductions needed. By 2030, the sum of NDCs reflects a reduction of between 5% and 10% compared to the current or baseline policy scenario. Therefore, the current national commitments, although more ambitious, remain insufficient (see figure 7) and if they are fulfilled, would be consistent with a temperature increase of 2.5°C. There are two emissions gaps: the first, owing to insufficiently ambitious targets, is equal to the difference between the emissions committed to in NDCs and the emissions consistent with the Paris Agreement. The second gap is implementation: the observed emissions pathway and current policies are not in line with NDCs, and the implemented policies lead to an emissions level above what is projected in the national commitments (IPCC, 2022b; UNEP, 2022).

Figure 7
World: reduction in emissions by scenario to 2030
(Percentage difference with respect to business as usual)

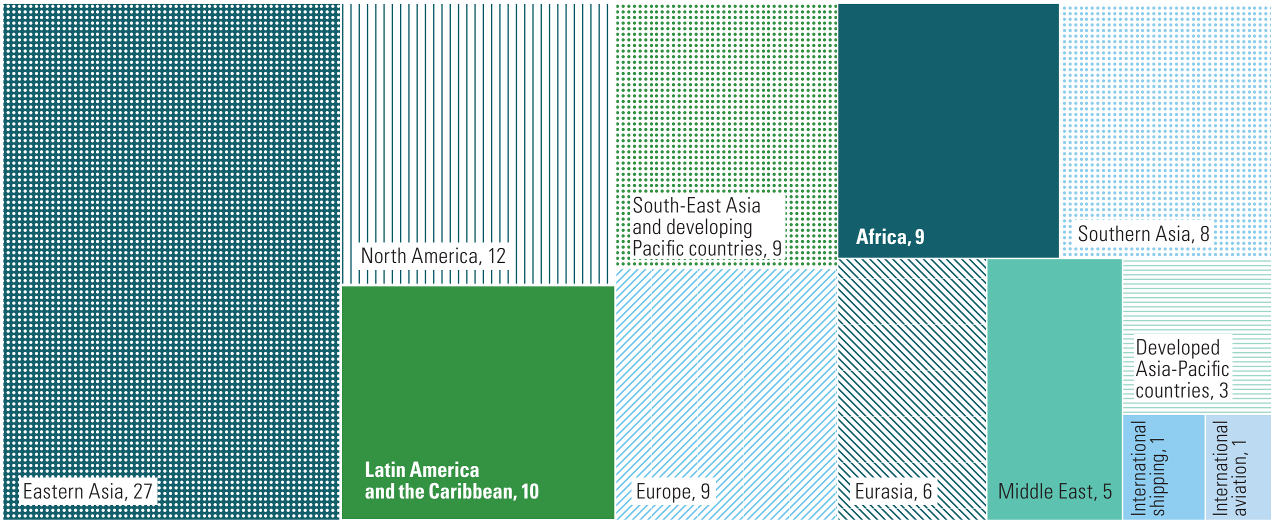


Source: Prepared by the authors, on the basis of United Nations Environment Programme (UNEP), *The Emissions Gap Report 2022: The Closing Window. Climate Crisis Calls for Rapid Transformation of Societies*, Nairobi, 2022.
Note: Unconditional NDCs refer to measures that would be carried out by countries using their own resources and capacities and conditional NDCs refer to additional measures that would be implemented if international support (e.g. financing and technical assistance) were provided.

D. Overview of emissions in Latin America

In 2019, emissions in the region amounted to 6 $GtCO_2eq$, 10% of the global total (see figure 8) (Minx and others, 2021; IPCC, 2022b). This represents average annual growth of 1.6% since 1990. The pace slowed, on a par with the regional economy, to 0.5% per year between 2015 and 2019. The Caribbean accounted for 3% of regional emissions, while Central America contributed 2%.

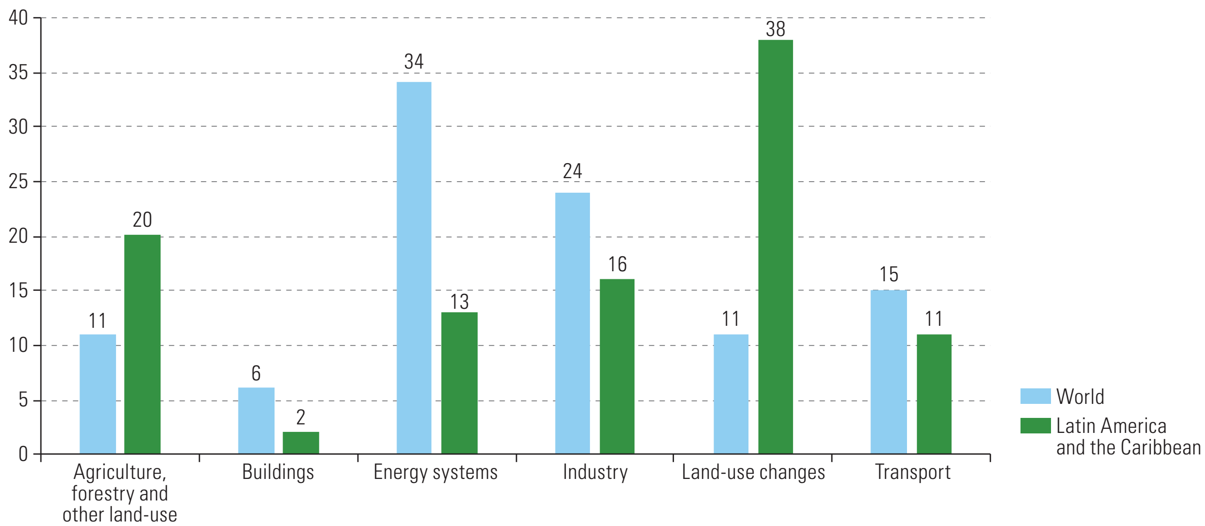
Figure 8
World: share of total global emissions of 60 $GtCO_2eq$, 2019
(Percentages)



Source: Prepared by the authors, on the basis of J. Minx and others, "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019", *Earth System Science Data*, vol. 13, No. 11, Göttingen, Copernicus Publications, 2021.

Globally, activities related to the energy system (electricity generation and heating; oil extraction and refining, which generate fugitive emissions) are the main source of greenhouse gas emissions; in the region, 38% of total emissions come from land-use change, mainly deforestation, and 20% from agriculture and forestry (see figure 9). This highlights the region's productive pattern, since agriculture accounts for 90% of deforestation (FAO/UNEP, 2020).

Figure 9
World and Latin America and the Caribbean: greenhouse gas emissions by sector, 2019
(Percentages)

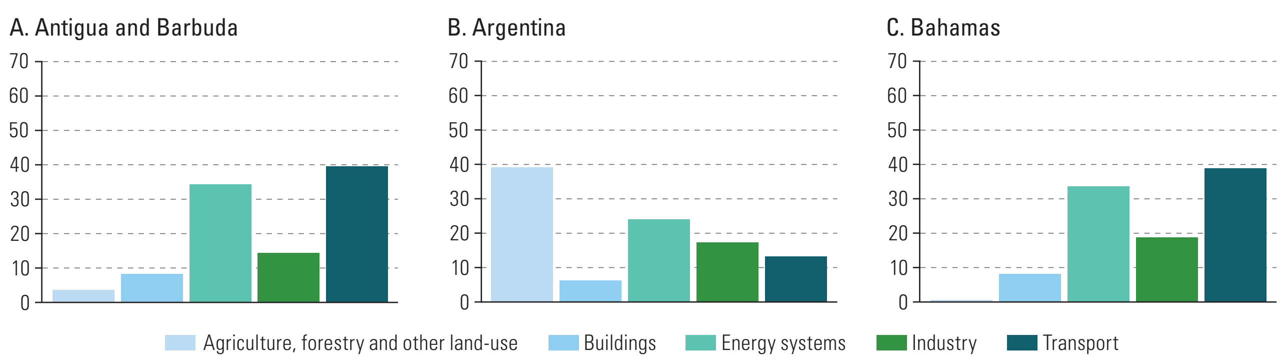


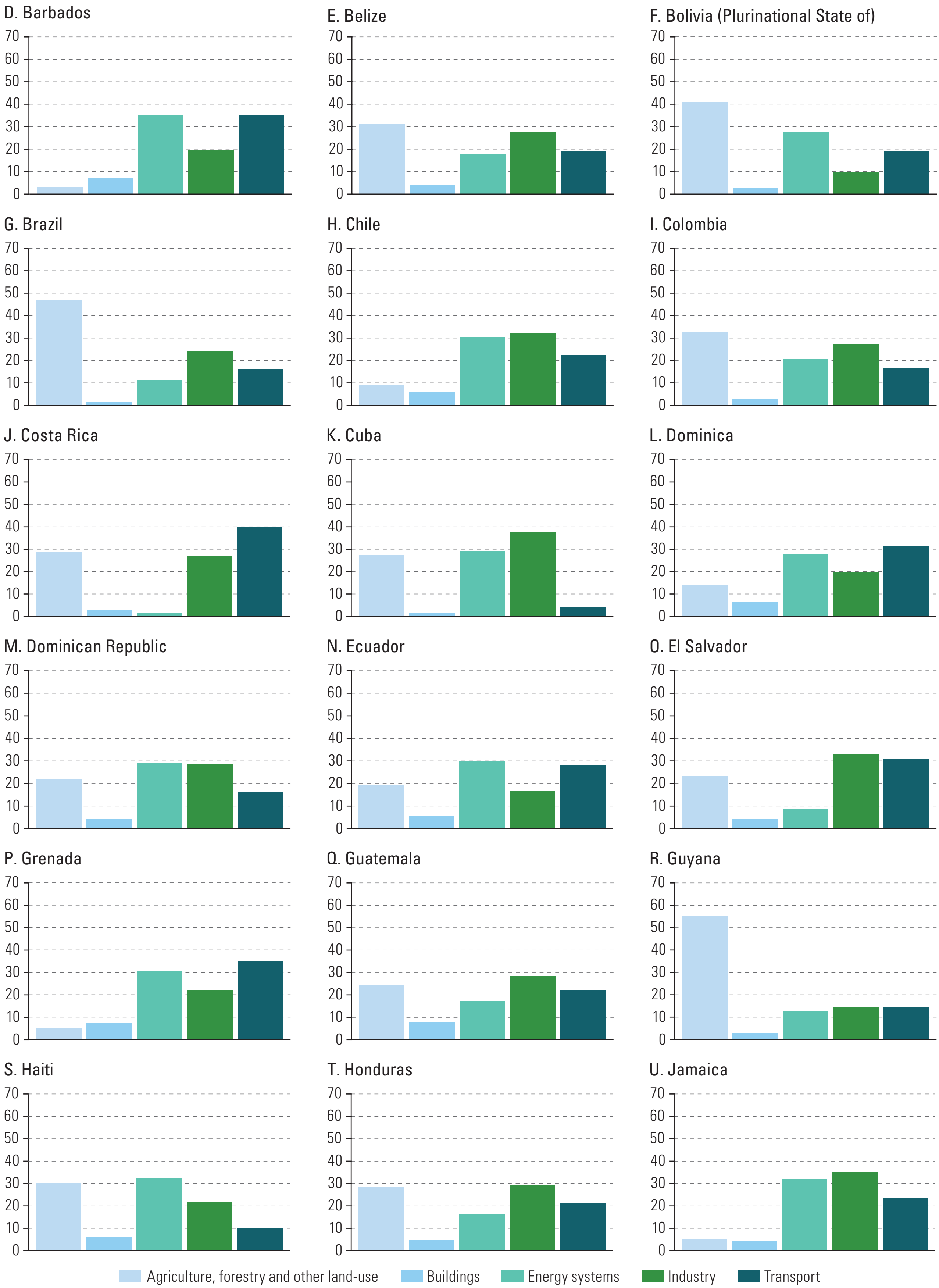
Source: Prepared by the authors, on the basis of J. Minx and others, "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019", *Earth System Science Data*, vol. 13, No. 11, Göttingen, Copernicus Publications, 2021.

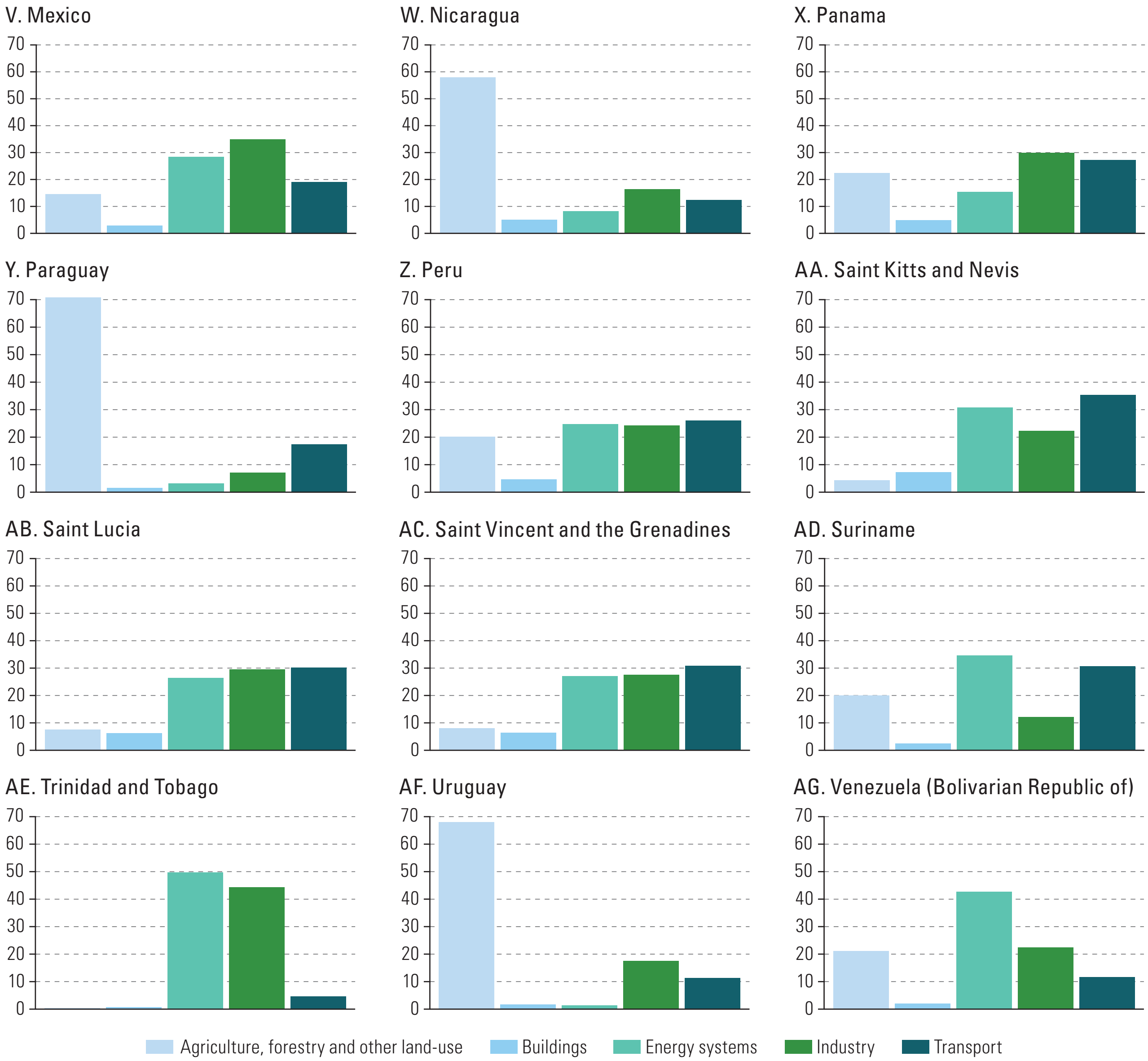
In the region, energy use in buildings, transport, electricity generation and distribution, and the energy system in general, produces 26% of emissions. Industrial processes and waste account for the remaining 16% (Minx and others, 2021).

Countries vary significantly in terms of energy mix, importance of the agricultural sector and loss of forest cover (see figure 10). This profile is determined by factors such as the productive structure, power generation and consumption patterns. Although countries face common challenges, they employ different mitigation strategies.

Figure 10
Latin America and the Caribbean (33 countries): greenhouse gas emissions by sector, 2019
(Percentages)




D. Barbados
E. Belize
F. Bolivia (Plurinational State of)
G. Brazil
H. Chile
I. Colombia
J. Costa Rica
K. Cuba
L. Dominica
M. Dominican Republic
N. Ecuador
O. El Salvador
P. Grenada
Q. Guatemala
R. Guyana
S. Haiti
T. Honduras
U. Jamaica
0
10
20
30
40
50
60
70
Agriculture, forestry and other land-use
Buildings
Energy systems
Industry
Transport



Source: Prepared by the authors, on the basis of J. Minx and others, "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019", *Earth System Science Data*, vol. 13, No. 11, Göttingen, Copernicus Publications, 2021.

E. Nationally determined contributions in Latin America and the Caribbean

In June 2023, 29 of the 33 countries in the region had submitted new climate action commitments. These countries account for more than 95% of regional emissions (see table 2). The new unconditional targets aim for a 24% reduction in emissions by 2030 with respect to a business-as-usual scenario and the conditional targets imply a 29% reduction in emissions (see figure 11). These are more ambitious than the unconditional and conditional targets of 13% and 23%, respectively, announced in 2015 (Samaniego and others, 2019 and 2022).

Antigua and Barbuda, Argentina, the Bahamas, Barbados, Barbados, Belize, Brazil, Chile, Colombia, Costa Rica, Dominica, the Dominican Republic, Guyana, Jamaica, Panama, Peru, Suriname and Uruguay have announced commitments to move towards carbon-neutral economies by mid-century (see table 2). These countries account for more than 50% of regional emissions. Argentina, Belize, Chile, Colombia, Costa Rica, Guatemala, Mexico and Uruguay have published their long-term low greenhouse gas emission development strategies up to 2050, as mandated in the Paris Agreement.

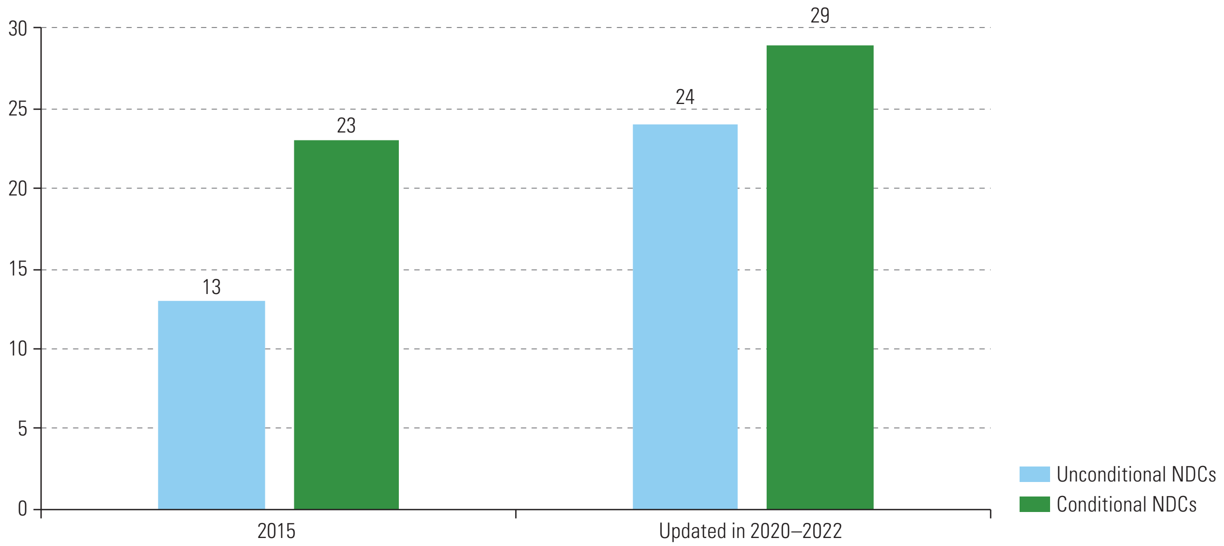
Table 2
Latin America and the Caribbean: nationally determined contributions

First NDCs, 2015 (4 countries)	Updated NDCs, 2019–2023 (29 countries)		
Ecuador Guyana[a] Saint Vincent and the Grenadines Trinidad and Tobago	Antigua and Barbuda[a] Argentina[a] Bahamas[a] Barbados[a] Belize[a] Bolivia (Plurinational State of) Brazil[a] Chile[a] Colombia[a] Costa Rica[a]	Cuba Dominica[a] Dominican Republic[a] El Salvador Grenada Guatemala Haiti Honduras Jamaica[a] Mexico	Nicaragua Panama[a] Peru[a] Paraguay Saint Kitts and Nevis Saint Lucia Suriname[a] Uruguay[a] Venezuela (Bolivarian Republic of)

Source: Prepared by the authors, on the basis of J. Samaniego and others, "Panorama de las actualizaciones de las contribuciones determinadas a nivel nacional de cara a la COP 26", *Project Documents* (LC/TS.2021/190), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.
Note: Antigua and Barbuda and Barbados are aiming for carbon neutrality by 2040 and 2030, respectively.
[a] Countries aiming for carbon neutrality by 2050.

NDCs identify priority sectors for climate action. The sectors most frequently targeted by adaptation measures are water resources, agriculture, health and biodiversity. Mitigation measures focus on the energy, land-use change and transport sectors.

Figure 11
Latin America and the Caribbean: emission reduction targets in original and updated nationally determined contributions
(Percentage reduction with respect to business-as-usual scenario)



Source: Economic Commission for Latin America and the Caribbean (ECLAC).
Note: NDCs submitted by the countries are mixed in terms of the sectors included, time horizons or the absolute, relative or measurement-based nature of emission reduction targets. Therefore, aggregating them means incorporating some assumptions that add uncertainty to the estimate. An additional source of uncertainty is the database used as a substitute for official data from national inventories.

Tables 3 and 4 show the priority sectors targeted by adaptation and mitigation measures on the basis of countries' NDCs.

Table 3
Adaptation: priority sectors

Country/sector	Water	Agriculture	Health	Biodiversity	Coastal areas and oceans	Land use, land-use change and forestry	Risk management	Forests	Infrastructure	Cities, human settlements and territorial planning	Energy	Tourism	Transport	Housing	Industry	Education	Social development
Antigua and Barbuda	■	■	■		■						■	■	■				
Argentina	■	■	■	■	■	■	■	■	■	■	■	■	■			■	
Bahamas	■	■	■	■	■			■	■	■	■	■	■				
Barbados	■	■			■		■			■		■					
Belize	■	■	■	■	■	■		■	■	■		■					
Bolivia (Plurinational State of)	■	■						■			■						
Brazil	■		■				■		■				■	■			
Chile	■	■	■	■	■	■	■		■	■	■	■					
Colombia	■	■	■	■	■		■		■		■		■	■	■	■	■
Costa Rica	■	■	■	■	■		■		■	■	■	■				■	
Cuba	■	■	■	■	■	■	■	■	■	■		■	■	■			
Dominica	■	■															
Dominican Republic	■	■	■	■	■		■	■		■		■			■	■	
Ecuador	■	■		■	■		■				■						
El Salvador	■	■	■	■					■				■				
Grenada		■		■								■					
Guatemala	■	■	■	■	■	■	■	■	■								
Guyana	■	■			■								■				
Haiti	■	■	■	■	■	■				■							
Honduras	■	■	■	■		■	■	■	■	■	■		■				■
Jamaica	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■		
Mexico	■	■	■	■	■	■	■	■	■	■				■			
Nicaragua	■	■	■	■		■			■	■							
Panama	■	■	■	■	■		■	■	■	■	■		■	■			
Paraguay	■	■	■	■		■	■	■	■	■	■		■				
Peru	■	■	■	■	■	■	■	■	■			■	■				
Saint Kitts and Nevis	■	■	■		■	■				■		■					
Saint Lucia	■	■	■		■	■	■		■	■		■	■			■	
Saint Vincent and the Grenadines	■	■	■	■	■	■	■					■					
Suriname	■	■	■	■	■	■			■								
Uruguay	■	■	■	■	■	■	■		■		■	■					
Venezuela (Bolivarian Republic of)	■	■	■	■	■	■				■							

Source: Prepared by the authors, on the basis of the countries' nationally determined contributions.

Table 4
Mitigation: priority sectors

Country/sector	Energy	Land use, land-use change and forestry	Transport	Agriculture	Waste	Industry	Forests	Infrastructure	Housing	Water
Antigua and Barbuda	●	●	●	●	●					
Argentina	●	●	●	●	●	●	●		●	●
Bahamas	●	●	●			●				
Barbados	●	●	●	●	●					
Belize	●	●	●	●	●					
Bolivia (Plurinational State of)	●	●		●	●	●				
Brazil	●	●	●	●	●	●	●			
Chile	●	●	●	●	●	●	●		●	
Colombia	●		●	●	●	●	●		●	
Costa Rica	●	●	●	●			●		●	
Cuba	●	●	●	●						
Dominica	●		●	●	●	●		●		
Dominican Republic	●	●	●	●	●	●				
Ecuador	●	●	●	●			●			
El Salvador				●						
Grenada	●	●	●		●	●				
Guatemala	●	●	●	●	●	●	●			
Guyana	●	●								
Haiti	●	●	●	●	●		●			
Honduras	●	●	●	●	●	●				
Jamaica	●	●	●	●	●					
Mexico	●	●	●	●	●	●	●		●	
Nicaragua	●	●	●	●			●			●
Panama	●	●	●	●	●					
Paraguay	●	●	●	●	●	●	●			
Peru				●	●	●				
Saint Kitts and Nevis	●		●							
Saint Lucia	●		●							
Saint Vincent and the Grenadines	●	●	●							
Suriname	●	●	●	●						
Trinidad and Tobago	●		●			●				
Uruguay	●	●	●	●	●	●				
Venezuela (Bolivarian Republic of)	●	●	●	●	●	●	●			

Source: Prepared by the authors, on the basis of the countries' nationally determined contributions.

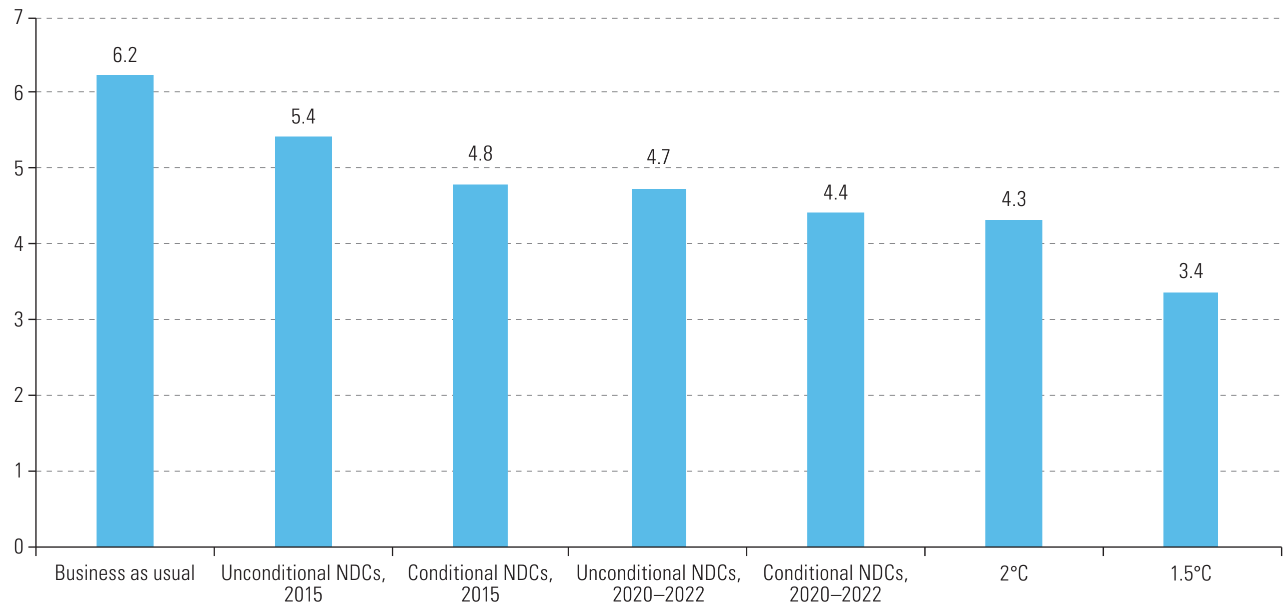
In 2030, regional emissions are expected to reach 6.2 $GtCO_2eq$. The level of emissions in a business-as-usual scenario would grow at a rate of 0.6% assuming low regional growth, such as that recorded between 2010 and 2019 (see table 5 and figure 12).

Table 5
Latin America and the Caribbean: greenhouse gas emissions scenarios, projections to 2030

Scenario	(a) Emissions in 2030 *($GtCO_2eq$)*	(b) Difference compared to business-as-usual scenario *($GtCO_2eq$)*	(c) Difference compared to business-as-usual scenario *(%)*	(d) Annual pace of decarbonization 2022–2030 *(%)*
Business-as-usual	6.2	-	-	-0.9
Unconditional NDCs, 2015	5.4	-0.8	-13	-2.4
Conditional NDCs, 2015	4.8	-1.4	-23	-3.8
Unconditional NDCs, 2019–2022	4.7	-1.5	-24	-3.9
Conditional NDCs, 2019–2022	4.4	-1.8	-29	-4.6
2°C	4.3	-1.9	-31	-4.9
1.5°C	3.4	-2.9	-46	-7.5

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

Figure 12
Latin America and the Caribbean: greenhouse gas emissions by scenario, 2030
(Gigatons of CO_2 equivalent)



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

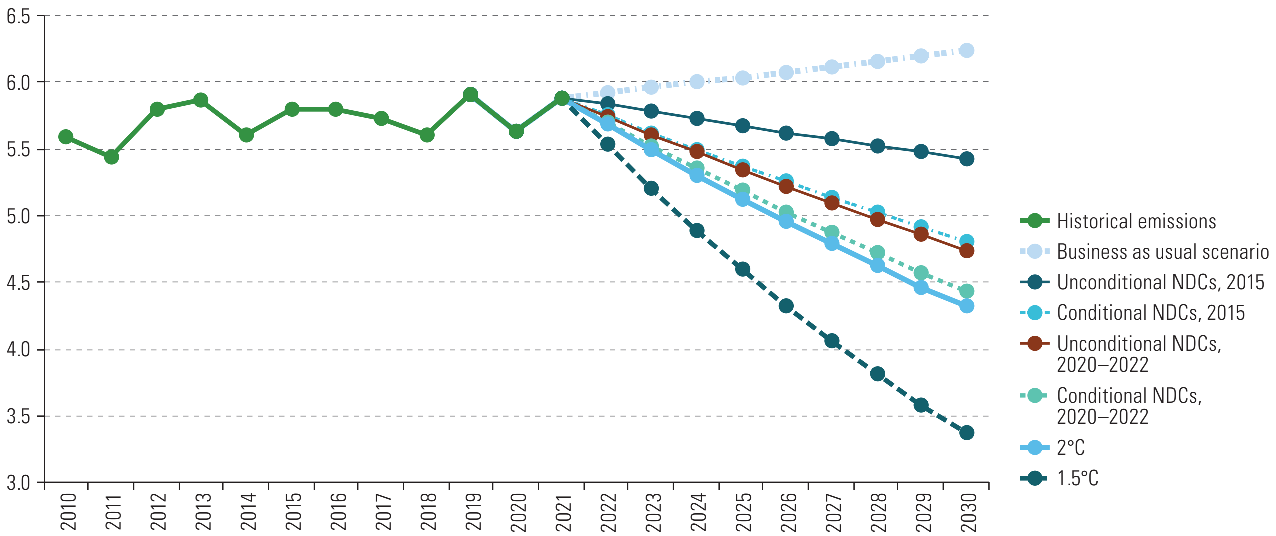
The overall target for Latin America and the Caribbean, conditional on external support, is close to the reduction needed to keep the temperature increase below 2°C. If the conditional NDCs are included, the level of reduction rises to 29% compared to the business-as-usual scenario in 2030 (see figure 13), the scenario consistent with 2°C.[3]

[3] As a reference point, it is assumed that all countries reduce their emissions by the same percentage.

Figure 13

Latin America and the Caribbean: greenhouse gas emissions, 2010–2030

(Gigatons of CO_2 equivalent)



Source: Prepared by the authors, on the basis of J. Minx and others, "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019", *Earth System Science Data*, vol. 13, No. 11, Göttingen, Copernicus Publications, 2021.

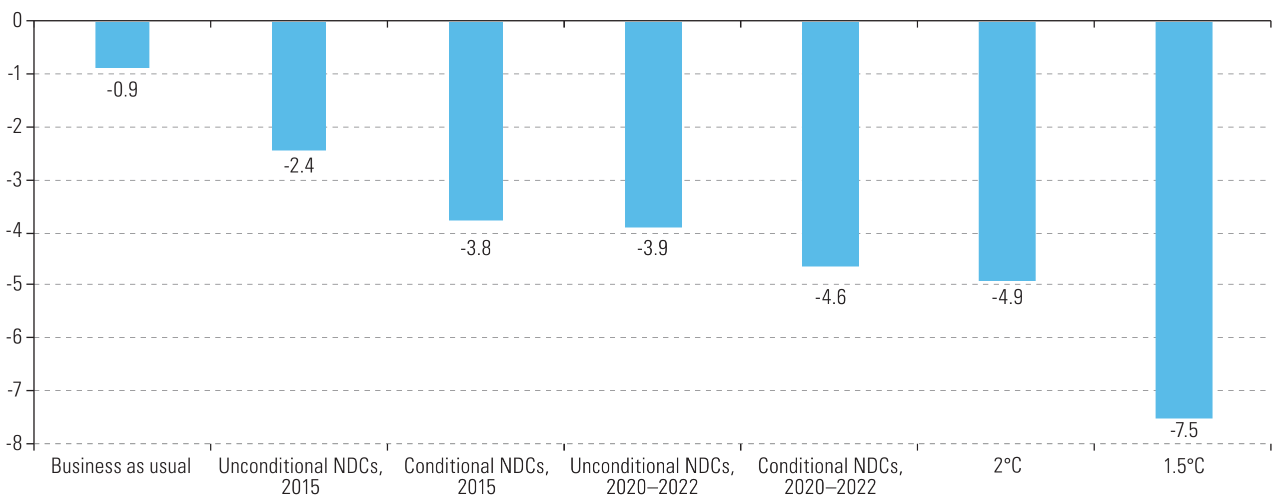
Under the principle of common but differentiated responsibilities, adaptation could be prioritized over mitigation, but emissions must also be reduced in order to make goods and services produced in Latin America and the Caribbean more competitive in the global markets of the future. In addition, various strategies to reduce emissions will benefit air quality in major urban centres by lowering public health costs and increasing productivity.

Achieving emission-reduction targets requires significant structural change. Between 2010 and 2019, the decoupling of emissions from GDP (decarbonization) occurred at an average rate of 0.9% per year. Achieving the goals established in NDCs means this must occur 4–5 times faster than the current level, and to meet the climate goals outlined in the Paris Agreement, 6–8 times faster (see figure 14).

Figure 14

Latin America and the Caribbean: annual pace of decarbonization by scenario

(Percentages)



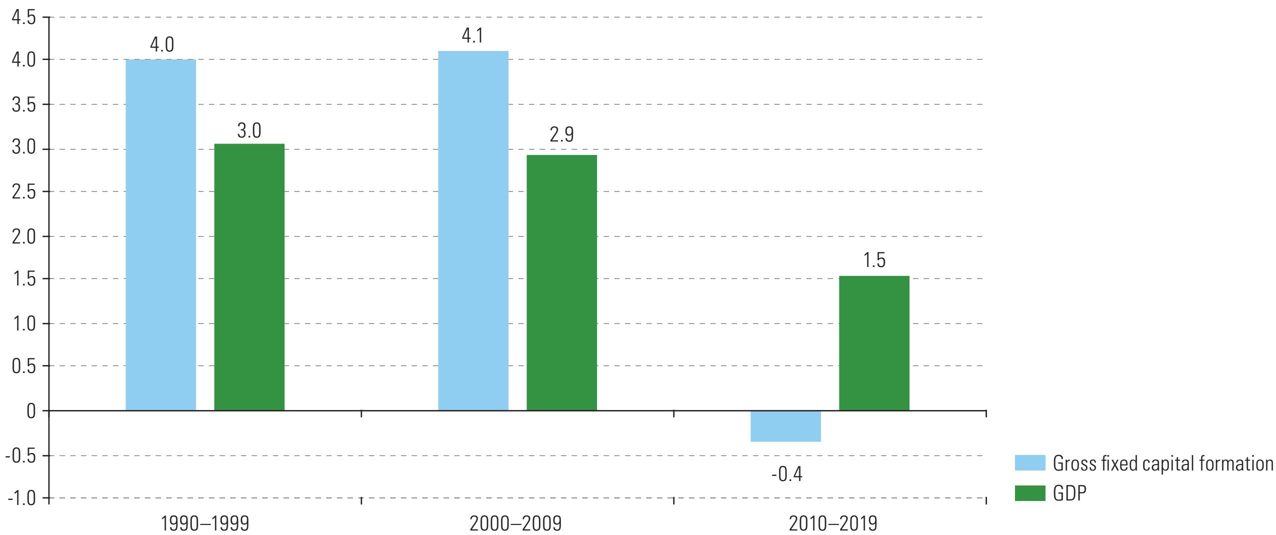
Source: Economic Commission for Latin America and the Caribbean (ECLAC).

F. Climate action and structural change

The transition to low-carbon and climate-resilient economies also represents an opportunity. Electricity generation through renewable sources, green hydrogen production, e-mobility, improved agricultural practices, development of the circular economy and nature-based solutions can reduce emissions while fostering economic growth, job creation and, potentially, better integration of the region into value chains (ECLAC, 2020 and 2022a). Given the regional emissions profile, avoiding deforestation and fostering reforestation is crucial. Investment in these and other transformative sectors can catalyse innovation, productivity and economic growth amid slow growth in the region.

Since 2010, the region's economic growth momentum has been weak. While the region recorded growth of around 3% per year, on average, from 1990 to 2009, that rate was halved in 2010–2019 (see figure 15) and, from 2014 to 2023, was just 0.8%, lower than the level reported in the lost decade of the 1980s. The weak momentum is explained in part by a drop in investment in the past decade, exacerbated by the effects of the pandemic and the invasion of Ukraine by the Russian Federation.

Figure 15
Latin America and the Caribbean: average annual growth in GDP and investment
(Percentages)



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

Economic growth levels are insufficient to achieve the various development goals. It is estimated that the economy must grow by at least 4%, on average, to generate jobs to reduce poverty and enable greater social investment to benefit the most vulnerable households (ECLAC, 2022b). Achieving 4% growth requires a significant investment effort. Since the 1980s, investment in the region as a proportion of GDP has remained close to 19%, well below that of economies such as China, India and the Republic of Korea, which have invested over 30% of their GDP, and below the world average of more than 20%.

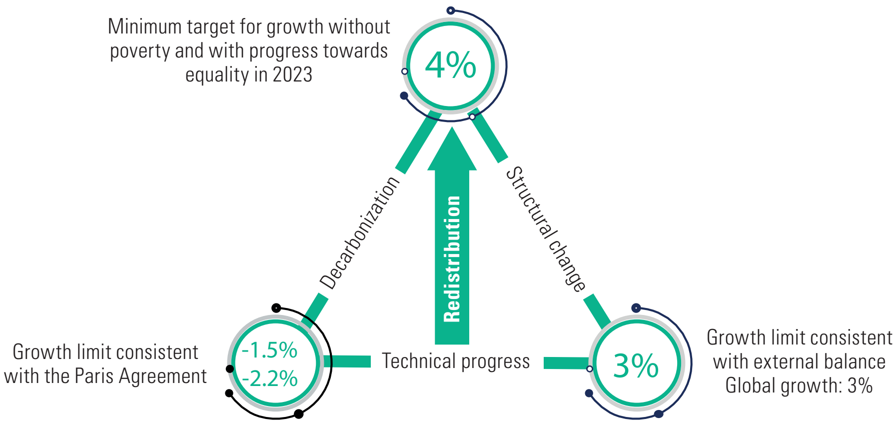
However, considering the region's open economy, growth of more than 4% per year will require minimum annual global growth of at least 4%, in order to maintain the external balance. According to current projections, the global economy will grow by 3% in 2023 and 2024, which implies limited regional growth or additional external financing requirements, and therefore, an increase in future indebtedness. Growth in Latin America and the Caribbean should be maintained at around 3% to ensure economic equilibrium.

In addition, for the region to meet its mitigation commitments, emissions must be reduced from the current 6 $GtCO_2eq$ to 4.4–4.7 $GtCO_2eq$ (see table 5). This implies that emissions should decline by between 2.4% and 3.1% each year until 2030. Assuming no change in the current economic structure or in production and decarbonization policies, annual economic growth would have to be limited to between -1.5% and -2.2% to achieve these reductions (see diagram 1). Alternatively, if the region grows by more than 4% per year to alleviate poverty, decarbonization of the economy should increase to at least 3.9% per year.

Under the current development model, the incompatibility of the growth needed to meet social objectives and the limits to growth imposed by both the productive structure (in terms of external constraints) and environmental objectives (in terms of emissions reduction), represents a dilemma. Convergence of these three growth rates depends on a good policy mix that simultaneously boosts growth by leveraging capacities and local content, decarbonizes the economy and creates employment by fostering poverty reduction. This implies the coordination of investments in transformative sectors.

Diagram 1

Growth rates consistent with social, environmental and economic targets in 2030



Source: Prepared by the authors.

Chapter II

Investing in climate action

A. Estimates of transition costs in Latin America and the Caribbean

B. Current climate financing and NDC investment needs in Latin America and the Caribbean

Achieving low-carbon and climate-resilient economies involves changing energy, food, transport and production systems. This will require significant investment. It is estimated that the global transition will require annual investments in the order of US$ 9.2 trillion by 2050. This includes investments in the energy system, mobility, industry, buildings and agriculture, and forestry and other land uses. This represents additional annual investments of more than US$ 3.5 trillion (McKinsey Global Institute, 2022), a projection in line with the estimates of the Global Financial Markets Association, which range between US$ 3 trillion and US$ 5 trillion per year until 2050 (GFMA/BCG, 2020).

The energy transition is one of the most resource-intensive areas. It is estimated that investment in clean energy must increase from US$ 1.8 trillion in 2023 to US$ 4.5 trillion by early 2030 to remain consistent with the 1.5°C target (IEA, 2023).

Studies vary considerably in their estimates of the cost of adaptation and are usually not comparable because of discrepancies in the definition of adaptation, the geographic regions and sectors considered, the time horizon of the analysis and the methodological approach (Galindo and others, 2014; Agrawala and Fankhauser, 2008; Stern, 2006). This affects the estimates of the global, regional and national funding needed for adaptation and resilience.

The most recent estimate comes from the Adaptation Gap Report 2022 (UNEP, 2022b) of the United Nations Environment Programme (UNEP), which includes estimates by region of the funding required by 2030. It is estimated that, worldwide, between US$ 41 billion and US$ 314 billion per year of funding is needed, or between 0.2% and 1.8% of global GDP.

These amounts must be added to the cost of addressing other challenges faced by developing countries. It is estimated that, to achieve the Sustainable Development Goals (SDGs), developing countries (excluding China) will need to increase spending on human capital, sustainable infrastructure (including for the energy transition), adaptation and resilience, and natural capital, from US$ 2.4 trillion (11.3% of GDP) in 2019 to US$ 3.5 trillion (18.2% of GDP) by 2030 (Songwe, Stern and Bhattacharya, 2022). This implies a funding gap equivalent to 6.9% of GDP. Climate investment, including for the energy transition, adaptation and resilience, and agriculture, forestry and other land use, must increase from the US$ 450 billion per year currently invested to US$ 2.3 trillion by 2030. This gap is equivalent to 4.8% of developing countries' GDP (see table 6).

Table 6

Developing countries: annual investment needed for sustainable development and climate action

(Billions of dollars and percentages of GDP)

	2019 *(Billions of dollars)*	2019 *(Percentage of GDP)*	2030 *(Billions of dollars)*	2030 *(Percentage of GDP)*	2019–2030 gap *(Billions of dollars)*	2019–2030 gap *(Percentage of GDP)*
Investment related to SDGs	2 385	11.3	5 880	18.2	3 500	6.9
Of which: Climate investment	450	2.1	2 250	6.9	1 800	4.8

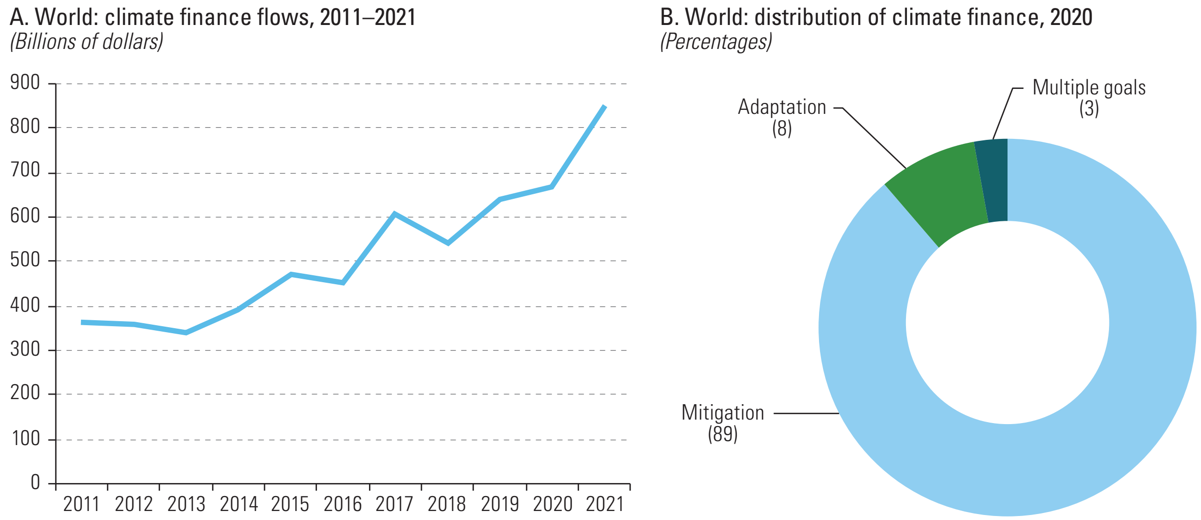
Source: V. Songwe, N. Stern and A. Bhattacharya, *Finance for Climate Action: Scaling Up Investment for Climate and Development*, London, Grantham Research Institute on Climate Change and the Environment, 2022. Report of the Independent High-Level Expert Group on Climate Finance (https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2022/11/IHLEG-Finance-for-Climate-Action-1.pdf) and Bhattacharya et al. (2022).

Note: Investments in human capital, sustainable infrastructure (including the energy transition), adaptation and resilience, and natural capital are among those related to the SDGs. Investments in the energy transition, adaptation and resilience, and agriculture, forestry and other land use are considered climate investments.

It is worth comparing these amounts with global climate finance flows,[4] which, in 2020, reached US$ 665 billion, or 3% of total global investment (Naran and others, 2022; IPCC 2022b). Although funding flows have grown rapidly and are now double the 2011 amounts, they remain well below the amounts required to achieve climate goals, and are highly concentrated on mitigation, in particular renewable energy generation. In 2020, 89% of climate finance was allocated to mitigation, 8% to adaptation and 3% to cross-cutting actions (see figure 16). Preliminary estimates indicate global climate finance flows of between US$ 850 billion and US$ 940 billion by 2021 (Naran and others, 2022).

[4] Global primary investment flows from public and private stakeholders in activities that reduce emissions and improve climate change adaptation and resilience.

Figure 16
World: climate finance flows



Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of B. Naran and others, *Global Landscape of Climate Finance. A Decade of Data: 2011-2020*, San Francisco, Climate Policy Initiative (CPI), 2022.

A. Estimates of transition costs in Latin America and the Caribbean

The amount of investment required for transition costs is also considerable for Latin America and the Caribbean. This study estimates that meeting climate action commitments requires a cumulative investment of between US$ 2.1 trillion and US$ 2.8 trillion over the period 2023–2030, equivalent to an average annual investment of 3.7% to 4.9% of regional GDP (between US$ 215 billion and US$ 284 billion).

For mitigation actions, the investment required is equivalent to 2.3%–3.1% of the region's annual GDP. The estimates include investments in the energy and transport systems and in reducing deforestation. The transport sector requires the most investment (see table 7).

The investment required for adaptation is estimated to be equivalent to 1.4%–1.8% of the region's annual GDP. This includes investments in early warning systems, poverty prevention, protection of coastal areas, water and sanitation services and protection of biodiversity. In this category, the largest amounts are for water and sanitation.

Table 7
Latin America and the Caribbean: annual investments required to meet nationally determined contributions, 2023–2030
(Percentage of regional GDP)

Sector	Percentage of GDP
Energy system	0.22–0.97
Infrastructure: transport	2.0
Electric public transport	0.02–0.08
Reducing deforestation	0.06
All mitigation	**2.30–3.11**
Poverty reduction	0.05–0.46
Infrastructure: irrigation	0.10

Sector	Percentage of GDP
Infrastructure: water and sanitation	0.70
Infrastructure: riverine and coastal flood control	0.28
Comprehensive early warning systems	0.012
Biodiversity (protected areas)	0.26–0.28
All adaptation	**1.40–1.83**
Total investment	**3.70–4.94**

Source: Prepared by the authors.

The sources of information for the amounts in table 7 are briefly presented below. The energy sector, electric public transport and investments to prevent deforestation are included in mitigation. Estimates of infrastructure investment for both mitigation and adaptation are also included. Adaptation estimates also factor in the necessary requirements for the designation of 30% of terrestrial and marine areas as protected areas, the funding required to forestall poverty increases as temperatures rise, and the cost of implementing efficient early warning systems, in particular for flooding and droughts.

1. Investment in mitigation in the Latin American and Caribbean energy sector

The estimates of the investments required by 2030 in the energy system[5] of the region[6] include investments for the addition or replacement of equipment for supply and for energy efficiency in several end-use sectors (buildings, transport and industry) (McCollum and others, 2018).

According to the findings of NGFS, compared with 2020 levels, annual investment over the period 2021–2030 will have to increase by between 0.2% and 1.0% of regional GDP to align with NDCs[7] (see table 8). This would be the equivalent of between US$ 13 billion and US$ 56 billion per year compared with 2020 investments. These data are consistent with the scenarios of the International Energy Agency (IEA), which state that the average investment flow for energy for final use in Latin America must increase by US$ 43 billion from 2021 to 2025 and by US$ 70 billion from 2025 to 2030, compared with the current average of US$ 119 billion (2016–2020) (IEA, 2021).

Table 8
Latin America and the Caribbean: average annual additional investment compared with investments in 2020, by integrated assessment model, 2021–2030
(Percentages of GDP)

Model	Percentages of GDP
MESSAGEix-GLOBIOM	0.22
REMIND-MAgPIE	0.97
REMIND-MAgPIE 2	0.95
Mean	0.71

Source: Prepared by the authors on the basis of Network for Greening the Financial System (NGFS), phase 3.
Note: GDP refers to GDP based on purchasing power parity.

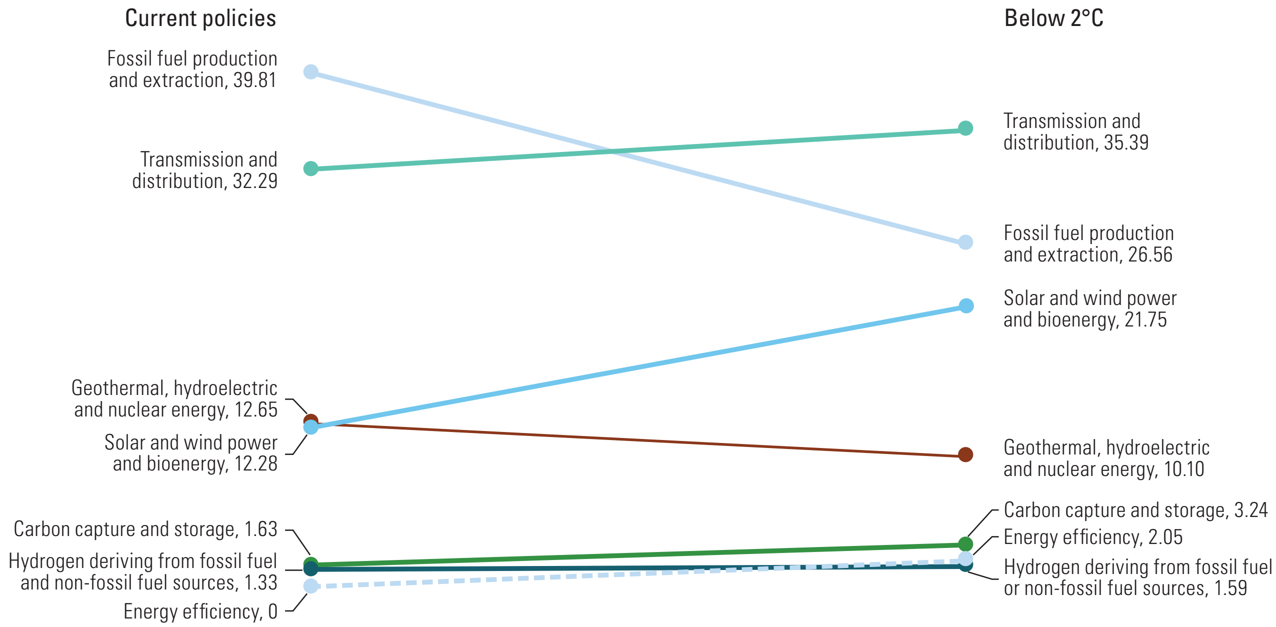
5 These results are taken from scenarios prepared for phase 3 of NGFS on the basis of integrated assessment models MESSAGEix-GLOBIOM 1.1-M-R12 and REMIND-MAgPIE 3.0-4.4 (including the expanded REMIND-MAgPIE 3.0-4.4 model, which includes physical impacts).

6 Includes Latin America and the Caribbean: Anguilla, Argentina, Bahamas, Barbados, Belize, Bolivarian Republic of Venezuela, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Grenada, Guadeloupe, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Mexico, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Plurinational State of Bolivia, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago and Uruguay.

7 As shown above, the region's NDCs are estimated to align with a temperature rise of 2°C, which is why the investment scenario selected is for a temperature rise of below 2°C.

The destination of investments in the NDC-consistent scenario differs from that of the current policies scenario. Investment in transmission and distribution becomes the most important item, accounting for 35% of total investment. Fossil fuel investment falls from 40% in the current policies scenario to 27% in the NDC-consistent scenario. Investment in renewables (solar, wind and bioenergy) rises from 12% to 21% (see figure 17).

Figure 17
Average annual share of investment, 2021–2030
(Percentage of mean annual total)



Source: Prepared by the authors on the basis of Network for Greening the Financial System (NGFS), phase 3.

2. Investment required for electrification of the public transport fleet

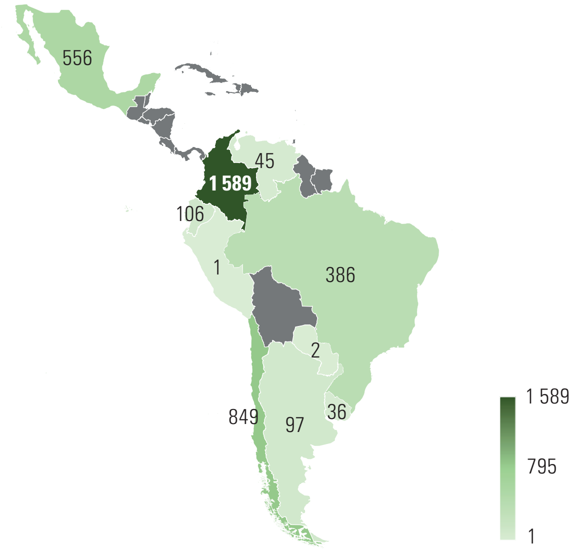
Latin America and the Caribbean has the highest per capita bus use in the world (UNEP, 2021) and almost 80% of the population live in urban areas. The transport sector is therefore key for achieving an accessible, sustainable and inclusive urban development plan.

Limited information is available on the region's public transport fleet. This study is therefore partial and refers to the data sample drawn from E-BUS RADAR. In December 2022, (see map 1) a total of 3,716 electric buses had been recorded in selected cities in 11 countries in the region, including trolleybuses (traditional and next generation), medium-sized battery-powered buses (8–11 m), standard buses (12–15 m) and articulated buses (over 18 m).

Colombia and Chile are the countries running the most electric buses, with around 1,580 and 850, respectively. More than 80% of the region's electric buses are supplied by Chinese companies. The capital cost (purchase price) of electric buses is higher than that of diesel and biodiesel buses. However, this is offset over time by the lower operating cost. Over the lifetime of a bus, electric buses become more economical than diesel buses after four years for standard buses (12 m) and 11 years for articulated buses (18 m).

ECLAC (2023a) calculated the cost in the region of having 30%, 50% and 100% of the total public transport fleet composed of electric buses (using the partial dataset available). The composition of the electric bus fleet in the region in December 2022 is taken as the baseline and trolleybuses are excluded.

Map 1
Latin America (11 countries): electric buses in December 2022
(Number of buses)



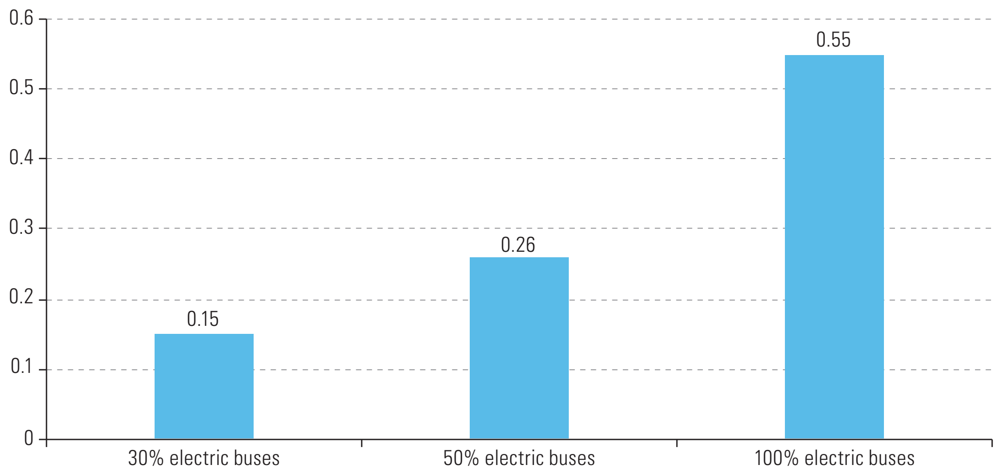
Source: Prepared by the authors, on the basis of Technical University of Denmark (DTU) and others, "E-BUS RADAR: Electric buses in Latin America" [online database] https://www.ebusradar.org/en/.

Note: The countries and cities included are: Argentina: Córdoba, Mendoza, Rosario and San Juan; Barbados: Bridgetown; Bolivarian Republic of Venezuela: Mérida; Brazil: Bauru, Brasilia, Campinas, Maringá, Salvador, Salvador - Metropolitan Region, Santos, São José dos Campos, São Paulo, São Paulo - Metropolitan Region and Volta Redonda; Chile: La Reina, Las Condes, Santiago and Valparaíso; Colombia: Bogotá, Cali and Medellín; Ecuador: Guayaquil, Quito and Santa Cruz; Mexico: Mexico City and Guadalajara; Paraguay: Asunción; Peru: Lima; Uruguay: Canelones and Montevideo.

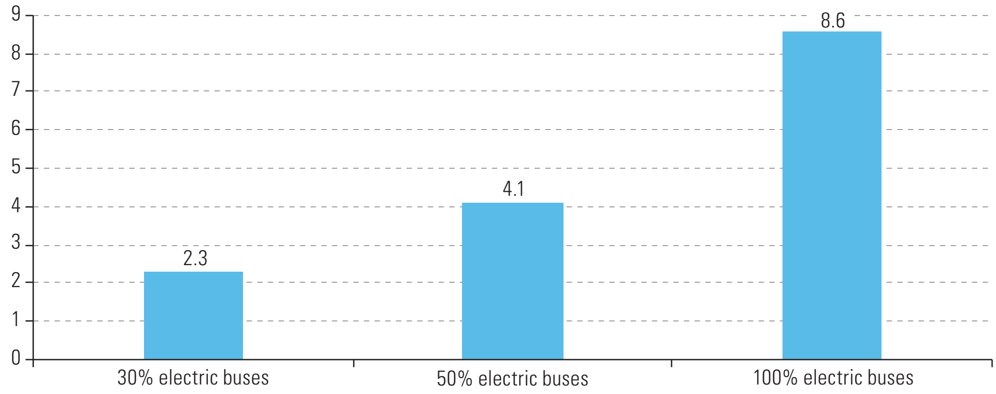
Figure 18 shows that, in the cities included, the capital cost of procuring enough electric buses to increase their share of the fleet from 5.6% to 30%, 50% or 100% would be the equivalent of between 0.15% and 0.55% of regional GDP at 2022 levels, or an average of between 0.02% and 0.08% per year. If 30% to 100% of the fleet were made up of electric buses, greenhouse gas emissions would fall by between 2.3 $MtCO_2eq$ and 8.6 $MtCO_2eq$. The sale of these emission reductions on a carbon market could generate funds and contribute to covering the capital costs. At US$ 60 per ton of CO_2 reduced, this could finance between 2.0% and 6.5% of the capital cost.

Figure 18
Latin America (11 countries): capital cost and impact of electric buses

A. Capital cost of electrification of public bus fleet in 2023
(Percentages of regional GDP in 2021)



B. Reduction of emissions
($MtCO_2eq$)



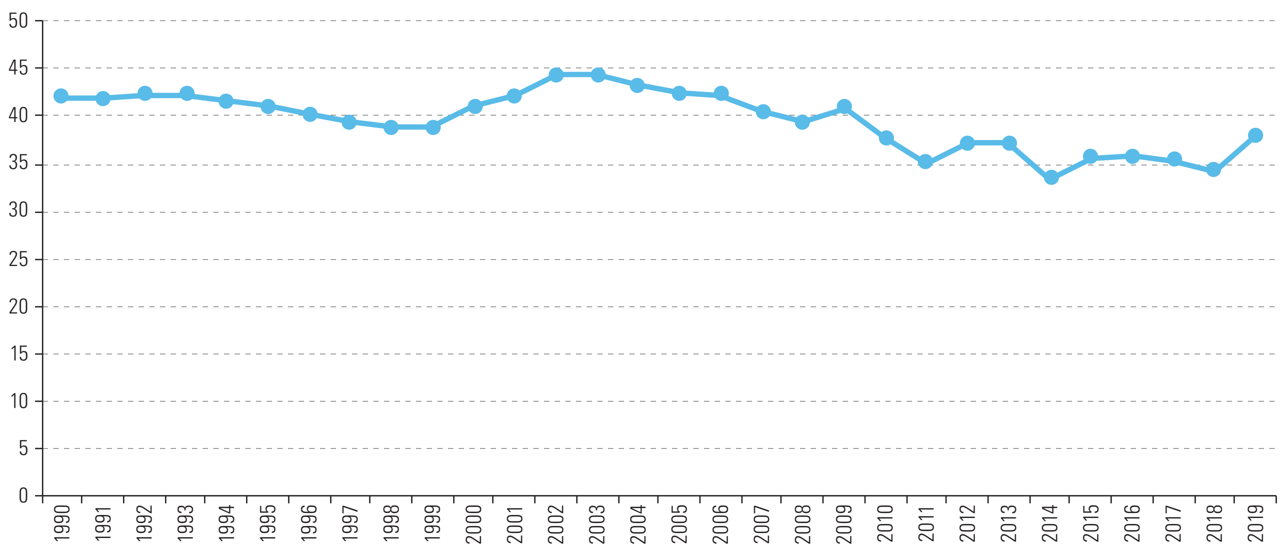
Fuente: Prepared by the authors, on the basis of Technical University of Denmark (DTU) and others, "E-BUS RADAR: Electric buses in Latin America" [online database] https://www.ebusradar.org/en/; Zero Emission Bus Resource Alliance (ZEBRA) [online] https://zebragrp.org/; United Nations Environment Programme (UNEP), *The Emissions Gap Report 2022: The Closing Window. Climate Crisis Calls for Rapid Transformation of Societies*, Nairobi, 2022.

Note: The countries and cities included in the estimate are: Argentina: Córdoba, Mendoza, Rosario and San Juan; Barbados: Bridgetown; Bolivarian Republic of Venezuela: Mérida; Brazil: Bauru, Brasilia, Campinas, Maringá, Salvador, Salvador - Metropolitan Region, Santos, São José dos Campos, São Paulo, São Paulo - Metropolitan Region and Volta Redonda; Chile: La Reina, Las Condes, Santiago and Valparaíso; Colombia: Bogotá, Cali and Medellín; Ecuador: Guayaquil, Quito and Santa Cruz; Mexico: Mexico City and Guadalajara; Paraguay: Asunción; Peru: Lima; Uruguay: Canelones and Montevideo.

3. Investment required for mitigation by preventing deforestation

In Latin America and the Caribbean, emissions from land-use change, mainly associated with deforestation, account for 38% of all greenhouse gas emissions (see figure 19). Although emissions have fallen by around 10 percentage points since the 1990s, the region was the world's largest emitter of greenhouse gas emissions generated by land-use change from 1990 to 2010, and now ranks second (according to data from 2010 to 2020) (FAO, 2020).

Figure 19
Latin America and the Caribbean: greenhouse gas emissions generated by land-use change (1990–2019)
(Percentage of total greenhouse gas emissions)



Source: Prepared by the authors, on the basis of J. Minx and others, "A comprehensive and synthetic dataset for global, regional, and national greenhouse gas emissions by sector 1970–2018 with an extension to 2019", *Earth System Science Data*, vol. 13, No. 11, Göttingen, Copernicus Publications, 2021.

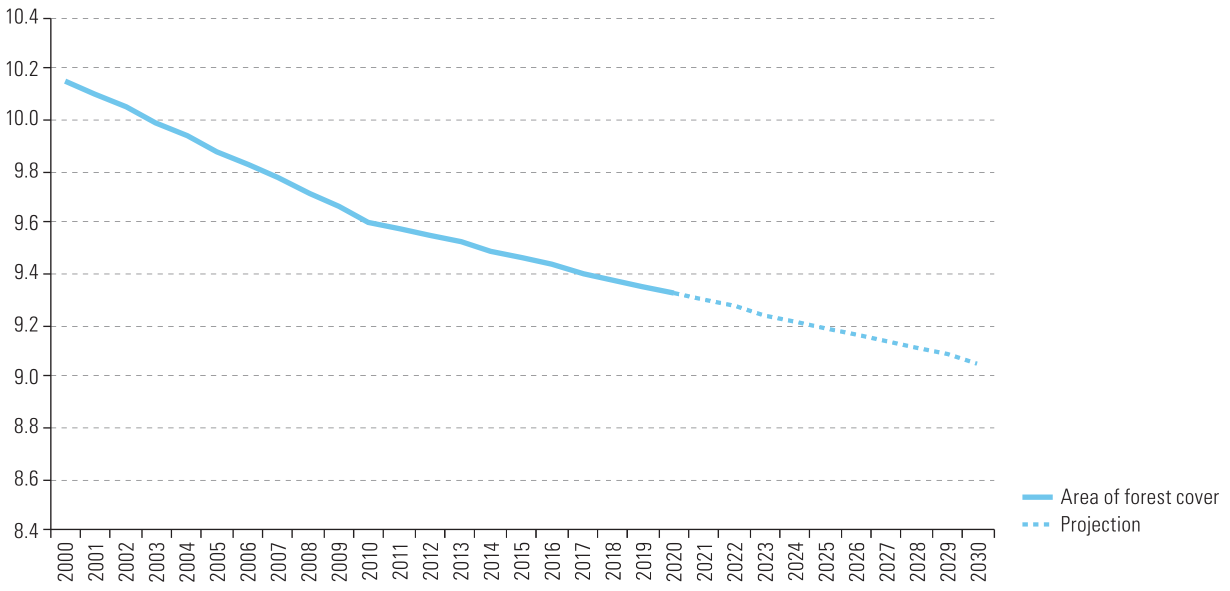
According to data from FAO (2020), deforestation in South America has fallen from an average of 5,837,000 ha/year over the period 1990–2000 to 2,953,000 ha/year over the period 2015–2020. A similar process has taken place in Central America, where the rate of deforestation has fallen from 228,000 ha/year in the 1990s to 168,000 ha/year over the period 2015–2020, although it remains higher than that of the previous five-year period (142,000 ha/year). In the Caribbean, the change has been more uneven, with the rate rising from 3,000 ha/year from 1990 to 2000 to 23,000 ha/year from 2010 to 2015, then falling to 5,000 ha/year from 2015 to 2020.

Given the large volume of greenhouse gas emissions from this sector for the region, most of the countries of Latin America and the Caribbean signed the Glasgow Leaders' Declaration on Forests and Land Use, presented at the twenty-sixth session of the Conference of the Parties to the United Nations Framework Convention on Climate Change, which stated, "we therefore commit to working collectively to halt and reverse forest loss and land degradation by 2030 while delivering sustainable development and promoting an inclusive rural transformation".[8] Prior to signing the Glasgow Leaders' Declaration on Forests and Land Use, several of the countries of the region had included their commitment on illegal deforestation by 2030 in their NDCs.

For pragmatic reasons, the calculations for the investments needed are approximate and based on market prices for land. In 2020, 9.3 million km^2 of the region's territory was covered by forest (see figure 20). From 2010 to 2021, surface area of 280,000 km^2 of forest was lost, equating to an annual rate of loss of 0.3%. If that trend were maintained, the region would lose an additional 272,000 km^2 by 2030.

The market price of the land cleared in the Amazonian region of Brazil is US$ 1,200 per hectare (Ardila and others, 2021). A preliminary estimate of the cost of reducing deforestation can be obtained by assigning an economic value to the deforested area. Assuming that the per-hectare market price is paid for the area expected to be deforested, thus preventing the deforestation, the average annual investment would correspond to 0.06% of regional GDP (the equivalent of US$ 3.3 billion).

Figure 20
Latin America and the Caribbean: forest cover, 2000–2030
(Millions of km²)



Source: Prepared by the authors, on the basis of World Bank, World Development Indicators [online database] https://databank.worldbank.org/source/world-development-indicators.

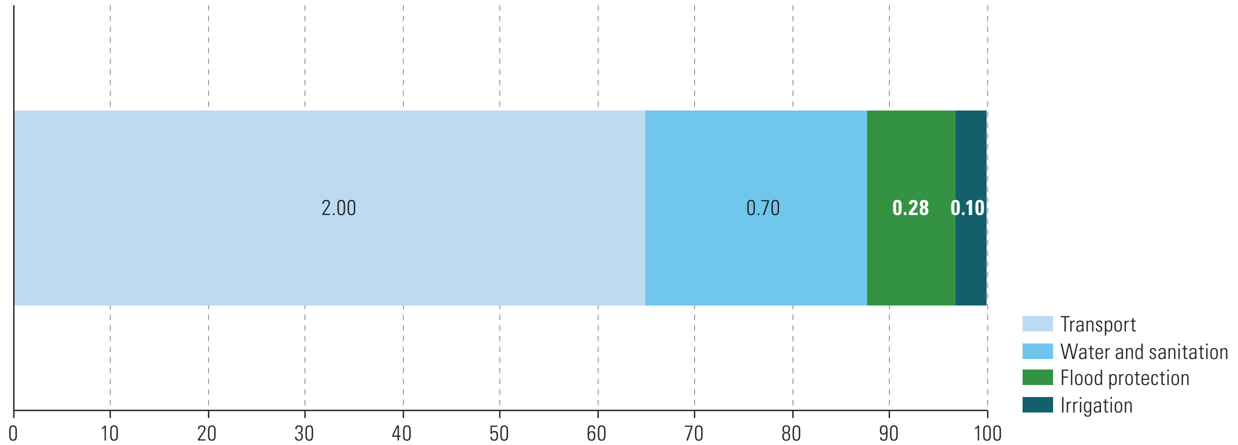
[8] The countries of the region that did not sign the Declaration were: Antigua and Barbuda, Bahamas, Barbados, Bolivarian Republic of Venezuela, Dominica, Plurinational State of Bolivia, Saint Kitts and Nevis, and Trinidad and Tobago.

4. Investments in mitigation and adaptation infrastructure

Rozenberg and Fay (2019) calculated the infrastructure cost, for low- and middle-income countries, of achieving the SDGs and keeping temperature rise below 2°C. For the Latin American and Caribbean region, they estimate that infrastructure investment equivalent to 3.1% of GDP is required over the period 2015–2030. As regards energy, investment is directed towards renewable energies and energy efficiency, and to gradually increasing access to electricity in poorer areas. In the transport sector, investment is directed towards increasing the rates of use of rail travel and public transport, increasing urban density and fostering e-mobility. Investment in water and sanitation focuses on providing drinking water and sanitation services, using high-cost technology in cities and low-cost technology in rural areas. Investment in flood protection is directed towards adopting Dutch protection standards for coastal flooding in cities and accepting the increased risk of riverine flooding on the basis of a cost-benefit analysis. Lastly, some investment is directed towards subsidizing irrigation infrastructure (Rozenberg and Fay, 2019).

The region's transport sector requires the largest annual investment in new infrastructure, accounting for 2% of GDP. The study also indicates that the annual investment required for the water and sanitation sector and for irrigation and protection against flooding represents 0.7% and 0.38% of GDP, respectively. Thus, the investment needed accounts fora total of 3.1% of regional GDP (see figure 21) (Rozenberg and Fay, 2019).

Figure 21
Latin America and the Caribbean: annual investment needs for new infrastructure, by sector 2015–2030
(Percentages of GDP)



Source: Prepared by the authors, on the basis of J. Rozenberg and M. Fay, *Beyond the Gap: How Countries Can Afford the Infrastructure They Need while Protecting the Planet*, Washington, D.C., World Bank, 2019.

In the transport sector, future demand for mobility can be met by investing in low-carbon infrastructure, switching to more railways and urban public transport. If policies that ensure the popularity of rail transport are also enacted, along with land-use policies to increase urban density, this scenario would cost an average of 1.4% of annual GDP from 2015 to 2030 and would align with the pathway towards limiting global temperature rise to 2°C (Rozenberg and Fay, 2019). The average cost from 2015 to 2030 of maintaining all transport infrastructure in the region could be as high as 0.6%.

The total cost of new technology for supplying water could reach an average of 0.5% of the region's GDP, in addition to annual average operating and maintenance costs that would account for 0.2%.

The main driver of future investment costs for irrigation is the degree of public support available, through subsidies for capital costs and maintenance, to enable the fullest potential use of irrigated land. The study estimates that the investment required for a modest level of public support for irrigation, to subsidize irrigation equipment but not water, would be around 0.10% of GDP per year.

Lastly, the amount of investment required for protection against coastal hazards and riverine flooding in the countries of Latin America and the Caribbean mainly depends on the level of risk acceptable for local populations and the uncertainty of construction costs. In the scenario chosen, Dutch protection standards are adopted for coastal flooding in cities and the increased risk of riverine flooding is accepted on the basis of a cost-benefit analysis. The protection strategy determines which coastal and interior areas invest in protection, such as barriers or dikes for high tides, and the level of protection, such as the return period for the flooding that the protection can withstand (ECLAC/University of Cantabria, 2015). On average, between 2015 and 2030, these investments could account for 0.28% of the GDP of the countries of Latin America and the Caribbean, of which 0.2% for new infrastructure and 0.08% for the maintenance of existing infrastructure.

5. The cost of biodiversity conservation

The conservation of biodiversity plays a key role in climate change adaptation and mitigation alike. For example, mangrove ecosystems capture and store carbon dioxide and protect coastlines, reducing the impact of extreme weather events on coastal areas (ECLAC, 2018a). The levels of investment needed to protect biodiversity are estimated on the basis of the costs of administering protected areas, which represent one strategic approach to mitigating the current biodiversity crisis.

In Latin America and the Caribbean, 2,300 key biodiversity areas span more than 3.2 million km^2, 56% of which benefit from some level of protection, while the remaining 43.8% has none whatsoever.

One of the main outcomes of the fifteenth meeting of the Conference of the Parties to the Convention on Biological Diversity, held in 2022, and the Kunming-Montreal Global Biodiversity Framework (building on the Aichi Targets of the Strategic Plan for Biodiversity 2011–2020), was the target to ensure that, by 2030, at least 30% of terrestrial and inland water areas, and marine and coastal areas are effectively conserved and managed through systems of protected areas and other effective area-based conservation measures. Protected areas in Latin America and the Caribbean facilitate the sustainable use of natural resources (biodiversity) by local communities and Indigenous Peoples; they are not meant to prohibit use but rather to increase the sustainability of such use.

The required investment in Latin America and the Caribbean is calculated on the basis of the share of the region's total protected areas in the global total.[9] Currently, there are 285,415 protected areas covering 48 million km^2 worldwide. The region accounts for 10,111 of those areas, covering 11 million km^2, or 22% of the global total.

Terrestrial areas account for 4,990,015 km^2 of the region's protected areas (approximately four times the size of Colombia). In other words, 24.29% of the terrestrial and inland water areas of Latin America and the Caribbean are protected. Marine protected areas, meanwhile, cover 5,597,417 km^2 (approximately three times the size of Peru), or 24.44% of the region's marine and coastal areas (see table 9). This leaves the region approximately 6% shy of the 30% target for both terrestrial and marine protected areas.

The investment required for the region is calculated by multiplying the cost per square kilometre of protected area by the number of square kilometres that remain to be protected and adding the cost of maintaining the existing protected areas as required by the 2030 target. Waldron and others (2020) estimate that the annual required investment to expand the global system of protected areas to achieve the 30% target is between US$ 103 billion and US$ 291 billion, depending on the scenario. This figure includes the minimum required budget to adequately administer the existing system of protected areas —US$ 67.6 billion annually (compared to just US$ 24.3 billion being spent currently)— and the cost of adding new areas to achieve 30% coverage for both terrestrial and marine protected areas —US$ 35.5 billion–US$ 224 billion annually. Thus, the annual cost per additional square kilometre would be between US$ 1,032 and US$ 6,510, while the cost per square kilometre of maintaining existing protected areas would be US$ 1,415.

[9] This calculation is based on the June 2021 version of the World Database on Protected Areas (WDPA). See [online] https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA.

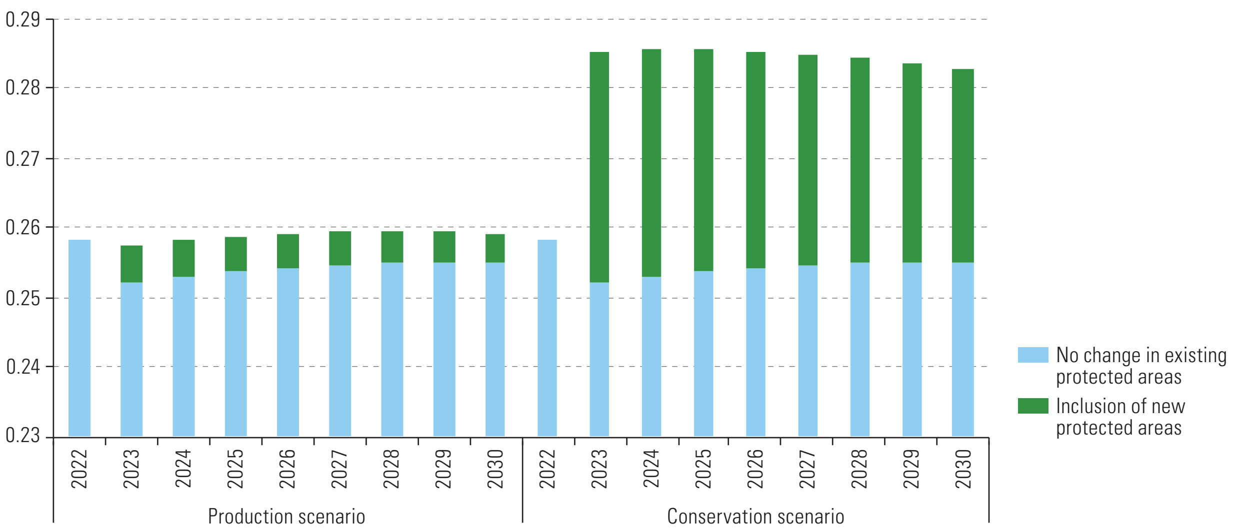
Table 9
Protected areas, by type and region
(Square kilometres and percentages of the world total)

Region	Type of protected area	Total protected area *(km²)*	Total territory *(km²)*	Protected area *(% of total)*
Asia	Protected land area and continental waters	4 788 941	31 130 454	15
	Marine protected area	11 694 946	61 347 771	19
Africa	Protected land area and continental waters	4 306 383	30 048 426	14
	Marine protected area	2 490 430	14 935 206	17
Latin America and the Caribbean	Protected land area and continental waters	4 990 015	20 541 462	24
	Marine protected area	5 597 417	22 902 092	24
Polar	Protected land area and continental waters	894 323	2 166 285	41
	Marine protected area	3 046 480	6 844 121	45
North America	Protected land area and continental waters	2 500 570	19 445 662	13
	Marine protected area	2 152 950	14 301 943	15
East Asia	Protected land area and continental waters	34 833	3 533 476	1
	Marine protected area	19 018	1 443 769	1
Europe	Protected land area and continental waters	3 802 576	27 811 406	14
	Marine protected area	1 496 390	17 542 705	9
	Global total	**47 815 272**	**273 994 778**	**17**

Source: Prepared by the authors, on the basis of Protected Planet, World Database on Protected Areas (WDPA) [online] https://www.protectedplanet.net/en/thematic-areas/wdpa?tab=WDPA.

Currently, the region's protected areas cover approximately 10.6 million km², which would need to be increased by 2.5 million km² to achieve the 30% target. If the region's protected areas increased by 306,000 km² annually starting in 2023, the total required investment would increase by an average of 0.26%–0.28% of GDP per year until 2030 (see figure 22).

Figure 22
Latin America and the Caribbean: annual required investment to conserve 30% of territory through protected areas, 2022–2030
(Percentages of regional GDP)



Source: Prepared by the authors.

6. Extreme events in Latin America and the Caribbean: early warning systems

Between 1970 and 2019, floods were the most frequent cause of disaster, accounting for 77% of deaths and 59% of economic losses in South America.[10] Droughts were responsible for the second-highest percentage of economic losses (28%). During that period, South America was struck by 875 disasters that left 57,909 dead, with a 5% increase between 2014 and 2019. Meanwhile, US$ 29 billion in economic losses were recorded in the period 2010–2019, representing an increase of more than 100% relative to the previous decade (WMO, 2021). In North and Central America and the Caribbean, economic losses due to extreme weather-, climate- and water-related events have increased tenfold in the past 50 years, with a recorded 1,977 disasters causing 74,839 deaths and US$ 1.7 trillion in economic losses. Between 1970 and 2019, the region accounted for 18% of weather-, climate- and water-related disasters, 4% of related deaths and 45% of associated economic losses worldwide (WMO, 2021).

The most frequent hazards —tropical cyclones (27%) and riverine floods (17%)— were responsible for the majority of deaths (60% and 14%, respectively). Tropical cyclones caused 58% of total damages in the region.

Risk information and early warning systems are increasingly considered key to diminishing these impacts. Worldwide, early warning systems have been identified as a priority, including by 88% of the least developed countries and small island developing States that have submitted their NDCs to the United Nations Framework Convention on Climate Change secretariat . Early warning systems are also included in article 6.5 of the Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (Escazú Agreement) (ECLAC, 2018b). A multi-hazard early warning system is a comprehensive system that alerts people to approaching hazards related to extreme weather events, including floods, droughts, heatwaves and storms, and provides information on how governments, communities and individuals can minimize imminent impacts.

The World Meteorological Organization (WMO) estimates that US$ 3.1 billion in investments are required for the period 2023–2027, or US$ 800 million annually, to ensure early warning systems that provide full coverage for the population of developing countries (WMO, 2023). In the Executive Action Plan on Early Warnings for All, 2023–2027, the "Observations and forecasting" pillar accounts for US$ 1.18 billion of the required investment, while the "Preparedness and response capabilities" pillar accounts for US$ 1 billion. These are two most costly pillars of the Executive Action Plan.

Implementing effective, comprehensive early warning systems that specifically address floods, droughts and water-related hazards for at least 100 developing countries over the period covered by the Plan would cost US$ 2.1 billion, or an average of US$ 525 million annually (see diagram 2). The cost of an early warning system covering the total population of developing countries, and of generating hydrometeorological information for decision-making to prepare for and respond to water-, hydrosphere- or cryosphere-related events, would be US$ 5.2 billion for the period 2023–2027, or US$ 1.3 billion annually.

For Latin America and the Caribbean, the regional share of the total global required investment for the period is US$ 2.8 billion. This amounts to US$ 700 million annually, or approximately 0.011% of the region's annual GDP.

[10] Economic losses include total economic damages and losses directly or indirectly related to disasters (as valued in the year of occurrence, without adjusting for inflation).

Diagram 2
Developing countries: budget for water-, hydrosphere- and cryosphere-related risks, 2023–2027

Knowledge of flood- and drought-related disaster risks US$ 12 million	• Global flood and drought risk mapping and information tool; development of tools and modules to assess and analyse the uncertainty of extreme conditions
Observations and forecasting US$ 1.65 billion	• Optimization of the hydrological observation network and monitoring; development of a global water data portal; implementation of the Hydro Status and Outlook System at global, regional and national levels; establishment of global centres on floods, drought and the cryosphere; development of regional, national and global data and products for urban, flash and riverine flood and drought modelling and forecasting systems (including the cryosphere)
Dissemination and communication US$ 360.6 million	• Development of global, regional and national flood and drought early warning platforms, including training; capacity-building activities, including curricula and training material based on needs identification, developed to enhance members' flood and drought management capacities and capabilities
Preparedness to respond US$ 75 million	• Simulation exercise to test the effectiveness of flood and drought early warning systems and platforms; capacity development relating to search and rescue operations for floods; coordination and collaboration with multiple stakeholders for effective flood and drought response
Total requirement: US$ 2.1 billion for the period 2023–2027	

Source: Prepared by the authors, on the basis of World Meteorological Organization (WMO), *Early Warnings for All: Executive Action Plan 2023–2027*, Geneva, 2022.

7. The cost of inaction on poverty is an adaptation cost

Global evidence shows that the relationship between economic production and temperature is not linear. Below a certain threshold, temperature rise has positive effects on production; above that threshold, production begins to decrease as temperature rises. This is consistent with the literature on the impacts of temperature on labour productivity and crop yields (IPCC, 2022a; Kalkuhl and Wenz, 2020). Temperature rise in the countries of the region has been sustained and significant since 1970. There is not yet sufficient evidence to identify an overall trend in precipitation, although trends are emerging in some areas, including an upward trend in the Bahamas and a downward trend in Chile.

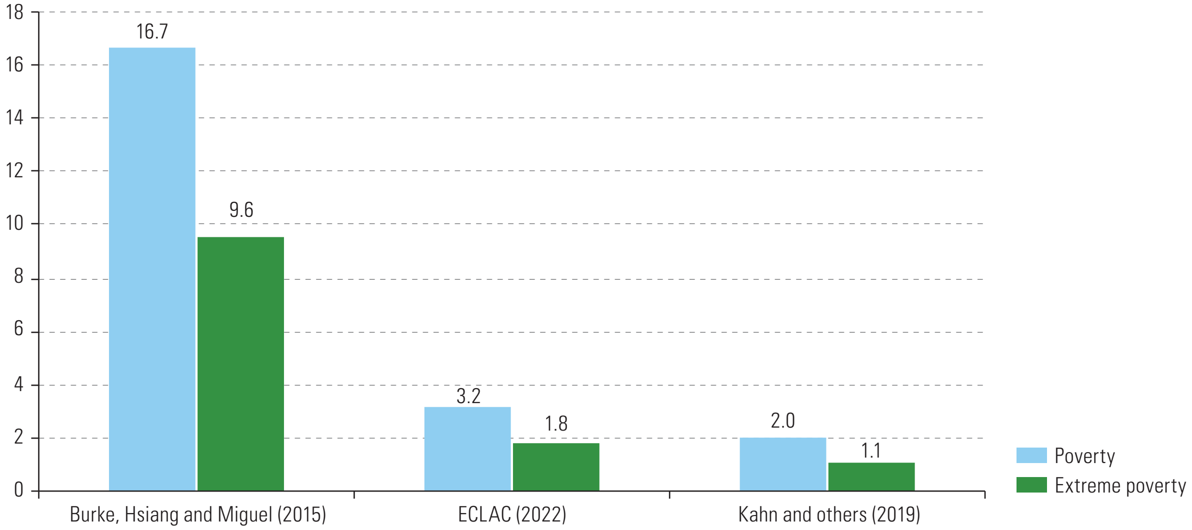
In a high-emissions scenario, the effects of climate change on global per capita GDP are expected to range from 0.8% to 5.1% in 2030 and from 2.5% to 15.3% in 2050. Burke, Hsiang and Miguel (2015) and Kahn and others (2019) conducted studies based on available data from approximately 25 countries in Latin America and the Caribbean. With these data, it is possible to obtain weighted estimates for the regional population in a high-emissions scenario[11] and compare them to the global estimates for 2030 and 2050 (Burke, Hsiang and Miguel, 2015; Kahn and others, 2019). ECLAC estimates (Van der Borght and others, 2023) situate the impacts on per capita GDP in the region's countries at -1.3% in 2030 and -3.3% in 2050. The impacts vary among countries.

Poverty levels for 2030 can be projected on the basis of the current growth trend in per capita GDP (1.7%) and compared with the projected poverty levels for a scenario of declining per capita GDP due to climate change. Climate change is expected to cause between 2 and 16.7 million additional people to fall below the poverty threshold and between 1.1 and 9.6 million to sink into extreme poverty (see figure 23). Poverty and extreme poverty levels in 2021 were estimated at 32.1% and 13.8% (201 million and 86 million), respectively (ECLAC, 2022c). Lower growth rates due to the chronic effects of climate change would hamper the region's ability to create jobs and reduce poverty.

11 In which national emissions reduction targets are not reached.

If a poverty line were assigned to the people affected by these chronic effects (approximately US$ 140 per month), the cost would range between US$ 3 billion and US$ 28 billion, or between 0.05% and 0.46% of regional GDP in 2030. This amount approximates the total adaptation funds required to address the economic impacts of climate change.

Figure 23
Poverty resulting from the chronic impact of climate change on per capita GDP, 2030
(Difference compared to a scenario without climate change, millions of people)



Source: Prepared by the authors, on the basis of M. Burke, S. Hsiang and E. Miguel, "Global non-linear effect of temperature on economic production", *Nature*, No. 527, Berlin, Springer, 2015; Economic Commission for Latin America and the Caribbean (ECLAC), *Social Panorama of Latin America, 2021* (LC/PUB.2021/17-P), Santiago, 2022; M. Kahn and others, "Long-term macroeconomic effects of climate change: a cross-country analysis", *NBER Working Papers*, No. 26167, Cambridge, National Bureau of Economic Research (NBER), 2019.

B. Current climate financing and NDC investment needs in Latin America and the Caribbean

In 2020, climate financing in Latin America and the Caribbean amounted to US$ 22.9 billion (0.5% of GDP) (see table 10). Of these flows, 90% came from multilateral development banks and green bonds (Samaniego and Schneider, 2023). In comparison, foreign direct investment (FDI) flows totalled US$ 161 billion in 2019 and US$ 105 billion in 2020 (ECLAC, 2021). Current financing as a percentage of GDP would have to increase seven-to-tenfold to meet investment needs.

Table 10
Latin America and the Caribbean: change in climate financing, 2013–2020
(Millions of current dollars)

Year	Climate funds[a]	Multilateral development banks	National development banks	Other local resources[b]	Green bonds	Total
2013	347.8	5 923.5	11 884.0	2 463.2	0.0	20 619
2014	420.7	7 857.3	11 783.0	1 967.3	246.0	22 274
2015	403.7	8 293.1	9 622.5	1 662.2	1 063.8	20 682
2016	364.8	7 308.6	4 561.2	849.4	1 689.4	14 773
2017	371.5	11 827.2	5 567.5	717.2	4 201.9	22 685

Year	Climate funds[a]	Multilateral development banks	National development banks	Other local resources[b]	Green bonds	Total
2018	601.4	9 881.2	4 402.3	722.0	1 621.9	17 229
2019	624.1	10 886.6	2 542.0	868.5	5 035.7	19 957
2020	669.17	10 672.6	1 537.0	631.85	9 400.0[c]	22 910
2013–2020	3 803.1	72 286.3	51 899.6	9 881.75	23 258.6	161 129

Source: J. Samaniego and H. Schneider, "Quinto informe sobre financiamiento climático en América Latina y el Caribe, 2013-2020", *Project Documents* (LC/TS.2023/85), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2023; International Development Finance Club (IDFC), *IDFC Green Finance Mapping Report 2021*, Paris, 2021; African Development Bank (AfDB) and others, *Joint Report on Multilateral Development Banks' Climate Finance 2020*, Abidjan, 2021; Caribbean Development Bank (CDB), *Annual Report 2020*, Bridgetown, 2021; Climate Bonds Initiative (CBI), *Bonds and Climate Change: The State of the Market 2018*, London, 2018; *Latin America & Caribbean: Green finance state of the market 2019*, London, 2019; *Sustainable Debt: Global State of the Market 2020*, London, 2020; *Latin America & Caribbean: State of the market*, London, 2021; European Investment Bank (EIB), Global Investment Map [online] https://www.eib.org/en/projects/map.htm; World Bank, "Maps" [online] https://maps.worldbank.org/projects/projectfilters; Climate Funds Update, Data Dashboard [online] https://climatefundsupdate.org/data-dashboard/; and Green Climate Fund data.

[a] Minus 5% of Fondo Amazonia, which corresponds to the natural resources of Brazil.

[b] Brazil, Colombia and Mexico: national climate funds and agricultural insurance; Chile: environmental protection fund.

[c] Data point from CBI (2021).

Chapter III

Policy recommendations

A. Transformative sectors

B. Importance of climate-related financial risk analysis and taxonomies for climate financing, the transformation of the financial system and productive development

C. Public policy instruments for climate action

D. Environmental democracy: a catalyst for informed and inclusive climate action

Multiple conclusions can be drawn from the foregoing analysis. The four recommendations highlighted for immediate action in this document do not preclude others. Their selection is based on their potential to impact relative returns, a criterion that is crucial for effectively internalizing the negative externalities of climate change. Solutions are available, but it is not always easy to make an economic case for their implementation owing to historic market structures and trends, institutional inertia and a lack of understanding of climate change and its implications.

A. Transformative sectors

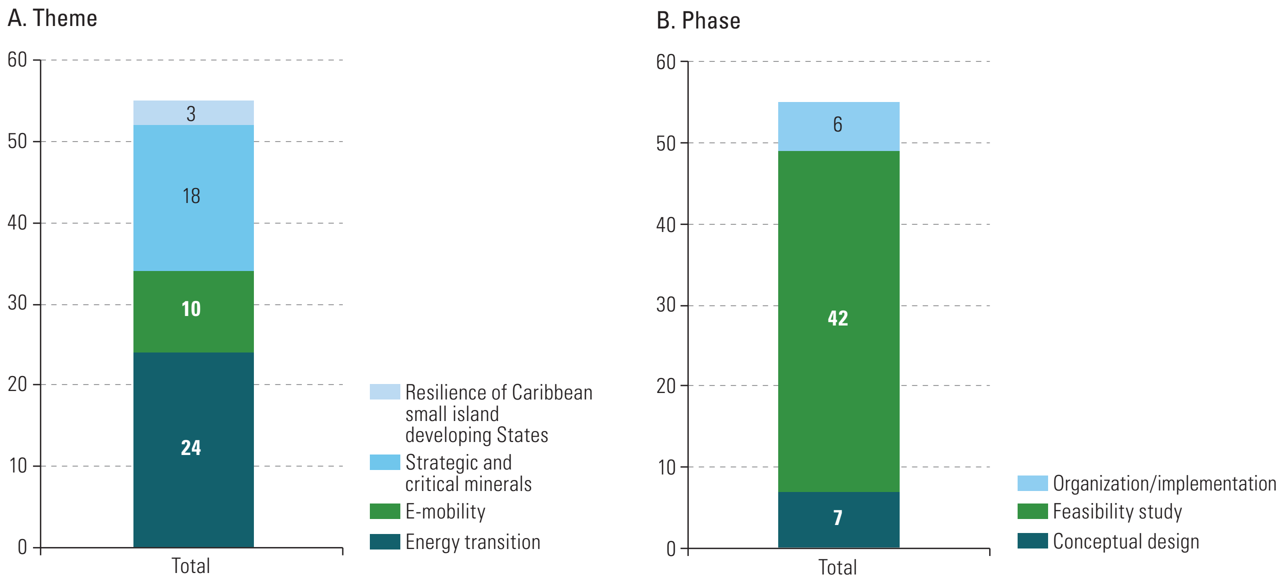
To follow a development path aligned with the SDGs, stimulus measures should be implemented in a series of transformative sectors that are capable of reducing countries' ecological footprints while creating decent jobs and having neutral or positive effects on the economy.

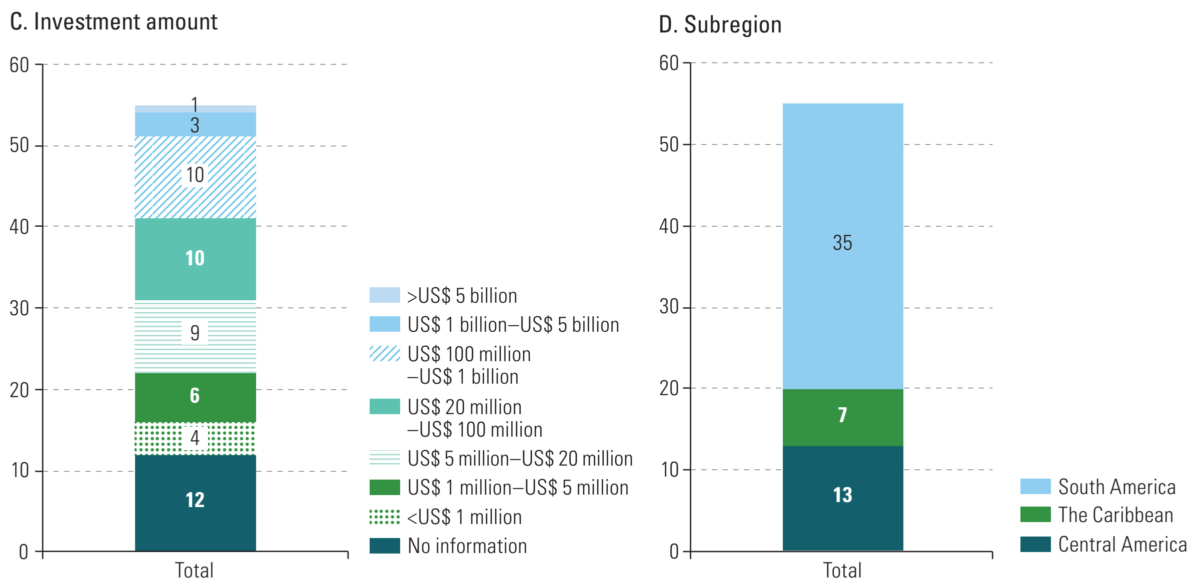
ECLAC has identified several priority sectors in the regional transition to carbon-neutral economies:

- Renewable energies
- E-mobility
- The circular economy
- The bioeconomy
- Water resources
- Sustainable tourism
- Food security

In that regard, a search for energy transition projects capable of attracting investors was conducted in 2022. The result of that exercise was highly illustrative of the challenges facing the transition process. Despite their relevance and strategic importance, projects did not meet the minimum requirements to attract private investors. Figure 24 shows the theme, phase, investment amount and subregion of each of the 55 projects covered in the exercise.

Figure 24
Latin America and the Caribbean: classification of projects by theme, phase, investment amount and subregion
(Number of projects)





Source: J. Samaniego and L. Sánchez (coords.), *Compendio preliminar de proyectos de inversión en acción climática para América Latina y el Caribe* (LC/TS.2022/133), Santiago, Economic Commission for Latin America and the Caribbean (ECLAC), 2022.
Note: These are preliminary figures, which do not include projects for which no impact has been estimated.

The result of the exercise, namely the determination that several strategic transition projects were "unbankable", indicates that there is much work to be done in a number of areas, including regulating new markets, developing new financial products and capacity-building for developers regarding project financing.

B. Importance of climate-related financial risk analysis and taxonomies for climate financing, the transformation of the financial system and productive development

In light of limited fiscal space and the magnitude of required investment for climate change adaptation and mitigation of greenhouse gas emissions, the financial system must be overhauled. This is key to ensuring the structural change needed to prevent the degradation of the habitat on which human survival depends. Political will for the green transition must translate into policies and instruments that dispel uncertainty about the path ahead.

A framework is needed in relevant market segments to drive the development of or shift towards assets aligned with decarbonization and resilience in accordance with the objectives of the Paris Agreement and other development goals (SDGs). Such a framework would need to create favourable conditions to redirect financial flows towards low-carbon activities. Countries need shared language and a clear definition of what is and is not green or environmentally sustainable in order to mobilize capital at the scale required for a green and inclusive economic transformation. Developing green finance taxonomies will provide the bedrock for systemic change in financial markets.

According to the International Capital Market Association, a green taxonomy is a system of classification to identify activities or investments that would boost a country's progress towards specific climate-related goals and targets. It would provide a basis for assessing whether and to what degree an activity underlying a financial asset supports or hinders specific environmental targets. This would help investors to circumvent risks associated with climate and societal decline, assess the environmental benefits of a given investment and contribute to quantifying the overall environmental impact of a given portfolio. It would also offer guidance to the financial sector on establishing transition strategies that are aligned with the Paris Agreement, including with respect to the parts of their portfolios and balance sheets that are currently carbon intensive.

Taxonomies based on scientific evidence reduce the risk of misleading and unfounded claims about environmental benefits, often referred to as "greenwashing". This in turn helps to protect investors and signals the financial sector to redirect funds towards economic activities aligned with the environmental targets of relevant jurisdictions.

Asymmetrical information and scattered approaches are among the main barriers to increasing market acceptance of sustainable finance. Addressing these barriers is particularly important for emerging and growing markets, as doing so would help to further integrate financial markets at the regional and international levels.

Increased regional integration need not translate into a one-size-fits-all solution. Flexibility is called for in adapting to the particularities of local economic structures and the variety of local ecosystems. However, a siloed approach could result in the proliferation of taxonomies, leading to market fragmentation, increased transaction costs, data inconsistencies and greater risk of greenwashing. These outcomes would make it more difficult to align financial flows with sustainability goals. A set of comparable and interoperable definitions, parameters and thresholds across jurisdictions, however, would lend credibility, integrity and transparency to the market. It would become easier to identify private sector investment opportunities, in particular for financial market actors. This scenario would help to mobilize capital for achieving the Paris Agreement targets and other environmental policy objectives, which would in turn facilitate the implementation of national strategies to further mobilize financing and capital for activities with neutral or positive effects on the planet.

In addition, when paired with a long-term perspective, as already envisaged by some strategies, taxonomies can be a powerful policy tool for productive development in accordance with the SDGs and the Paris Agreement. Taxonomies can be instrumental in realizing the legitimate regional ambition of a green transition to combat climate change and environmental degradation and address social inequality, with a view to driving market competition in a sustainable, carbon-neutral and climate-resilient future.

Climate-related financial risk analysis is equally fundamental and complementary to taxonomies. Risks are grouped in two categories:

- Physical risks refer to the acute and chronic impacts of climate change on the population, assets and value chains.
- Transition risks derive from drastic changes in markets that are rapidly transforming to mitigate their greenhouse gas emissions or better adapt and become more resilient to climate change.

To account for these risks, the Task Force on Climate-Related Financial Disclosures developed a set of recommendations structured around four thematic areas: governance (incorporating analysis and strategy into decision-making at the highest levels); strategy (understanding climate change as the new reality in which business will be conducted); risk management (identifying, analysing and managing climate risks); and metrics and targets (identifying risk indicators and maximum levels of risk to which businesses should be exposed).

The tools for analysing these risks have improved, despite the uncertainty surrounding the pace and magnitude of the effects of climate change, as well as its speed and scope. Foresight models are one key tool in that regard, taking into account the complex interrelationships between macroeconomics and climate change, and the effects of macroeconomic change on various sectors.

Developing integrated assessment models and broadening the range of stakeholders that understand their application and results will improve capacities to address climate risks and to leverage the economic opportunities that the green transition presents.

C. Public policy instruments for climate action

Providing a sufficiently swift response to the challenges posed by climate change, to prevent potentially irreversible effects and irreparable damage, calls for a variety of policy instruments aimed at reorienting behaviour by those responsible for generating emissions and at taking action to adapt to new climate conditions. In addition to the well-known nationally determined contributions, long-term climate strategies and national and sectoral climate change adaptation and mitigation strategies, the various other instruments available include those of an economic nature, such as carbon pricing, and command and control instruments, which are more closely linked to regulations and rules.

1. Carbon pricing instruments

In terms of economic theory, carbon pricing is based on setting a price for pollution caused (Pigovian taxes). In other words, carbon pricing aims for the social cost of emission of a ton of carbon to be priced into the cost structure of those responsible for the emissions. Such instruments endeavour to incentivize reductions in economic agents' emissions by adjusting their decisions regarding production and consumption (technological change) or for those agents to pay for the social cost of the pollution they generate.

Carbon pricing instruments include carbon taxes and emissions trading systems. In the case of carbon taxes, governments set prices through the legislature and let the market determine total emissions. With emissions trading systems, governments set a cap on emissions and let the market determine prices (by creating emissions permit supply and demand). In the middle ground between these two instruments are offset systems, which make it possible to offset the emissions of a regulated economic agent by ensuring an equivalent reduction by another company, which may be in another sector, area or even jurisdiction.

In Latin America and the Caribbean, although fuel taxes and fees have historically been employed (mainly to increase tax revenue), specific taxation of carbon is relatively recent, having been first rolled out in 2014 in Mexico. To date, just 5 countries in the region have introduced a carbon tax as part of national tax reforms, each with specific characteristics but also some similarities. Table 11 outlines the features of the carbon taxes established in Mexico, Chile, Colombia, Argentina and more recently in Uruguay.

Table 11
Latin America (5 countries): features of carbon taxes

Country	Year launched	Carbon dioxide tax	Tax base	Tax rate *(US$/ton of carbon dioxide equivalent emission (CO_2eq))*	National coverage *(Percentage of national greenhouse gases covered)*
Mexico	2014	Fuel Tax, Carbon Content	Purchases/sales of fossil fuel All fuels except gas	1–4	30
Chile	2017	Emissions Tax. Article 8 of Law 20.780 and its subsequent simplification in Law 20.899 Regulations for the offset system have yet to be passed	Emissions from boilers/turbines (>50 MW) All sectors and fossil fuels, except biomass	5	42
Colombia	2017	Fuel Tax, Carbon Content Article 221 of Law 1819 of December 2016 Article 47 of Law 2277 of December 2022 (amending the previous law) The permitted percentage of offsets in the carbon tax reform is 50%	Purchases/sales, imports or collection (for own consumption) of fossil fuels All fossil fuels, including all petroleum products, fossil gas and solids used for combustion	4.43	20
Argentina	2018	Fuel Tax, Carbon Content. Heading III of Law 23.966	Purchases/sales of fossil fuel All sectors except biofuels	1–10 (2019–2028)	40
Uruguay	2022	Tax on carbon dioxide emissions from consumption of gasoline. Presidential Decree 441/021 Decree 435/022 set the rate for 2023	Purchases/sales of fuel Gasoline with a 95 or 97 research octane number (RON) octane rating	155.86	10

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of official information and World Bank, World Development Indicators [online database] https://databank.worldbank.org/source/world-development-indicators.

In the region, carbon taxes are largely being implemented at the national level; however, in the case of Mexico, there are subnational carbon tax initiatives such as those in the states of Durango, Guanajuato, Estado de México, Querétaro, Tamaulipas and Yucatán. Table 12 summarizes the characteristics of subnational carbon taxes in Mexico.

Table 12
Mexico (6 states): characteristics of subnational carbon taxes

State	Year launched	Taxable event	Tax rate *(US$/ton of CO_2eq)*	Flexibility mechanism	Use of revenue
Durango	2022	Stationary sources Carbon dioxide, methane and nitrous oxide	9.9	To be determined	To be determined
Guanajuato	2023	Stationary sources Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride	13.8	20% tax incentives, price thresholds and natural gas use	Priority given to projects aimed at environmental and economic improvements
Estado de México	2022	Non-federal stationary sources Carbon dioxide, methane, nitrous oxide	2.37	None	Measures to ensure a healthy environment
Querétaro	2022	Stationary sources Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride	32.07	Up to 20% of offsets, tax incentive	Infrastructure work and environmental projects
Yucatán	2022	Stationary sources emitting more than 500 metric tons of CO_2eq per year Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride	15.46	Tax incentives to prevent, reduce or capture emissions	Ensure health protection and access to a healthy environment
Zacatecas	2017	Stationary sources Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride	14.78	None	Priority given to projects aimed at environmental and economic improvements

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of J. Garcia and others, "Impuestos al carbono en estados mexicanos", Mexico City, Mexican Carbon Platform (MexiCO2), 2022; World Bank, World Development Indicators [online database] https://databank.worldbank.org/source/world-development-indicators.

2. The social price of carbon

Taxes are not the only way to implement a cost or valuation for carbon. When rules or regulations are met, there is an implicit cost of carbon. In this respect, another means of setting a cost of carbon is by assigning a value to emissions (as can be done for any externality) when assessing investments applied in the financial sector or in methodologies for assessing public or private investment: a shadow price or social price of carbon. Unlike a tax, which is distributed over a short period (in other words, emissions in the current year), a social cost distinguishes between carbon-intensive and low-carbon investments over their life cycle, depending on their amount. The idea behind the social price of carbon is that the process of assessing investments rules out those that are cheaper but pollute more, by including at least part of their social cost, linked to greenhouse gas emissions. This alters the returns offered by different investment options in favour of those that are lower in carbon emissions.

The High-Level Commission on Carbon Prices, created in 2017 with Joseph Stiglitz and Nicholas Stern as chairs, noted that a "a well-designed carbon price is an indispensable part of a strategy for reducing emissions in an efficient way" and that "explicit carbon pricing can be usefully complemented by shadow pricing in public sector activities" (social carbon pricing) (High-Level Commission on Carbon Prices, 2017), Private investors, in view of the risk of the transition to a low-carbon economy resulting in stranded assets, are also starting to factor carbon prices into their financial decisions, even in territories where such prices are not yet applied.

Including the social price of carbon in cost-benefit analysis is useful when evaluating public projects and policies. Doing so enables quantification of the potential impact of climate change when evaluating a project; the social price of carbon simplifies selection of the most socially desirable option, by making it the solution with the highest present value.

There are several methodologies for calculating the social price of carbon, including the social cost of carbon (SCC), the abatement cost to achieve a public policy goal, and the evidence-based policy definition. The first of these options, the social cost of carbon, is based on calculating the marginal damage resulting from climate change; the second methodology is based on estimating the shadow price of marginal abatement costs, subject to a carbon budget constraint. Another option is to adopt a social price of carbon based on previous work by third parties, either from a review of the literature (recommendations made by IPCC), international experiences (social cost of carbon estimated and applied by another country) or the price from an emission permits market (such as the clean development mechanism (CDM)).

The most technically accurate method is to calculate the social cost of the marginal carbon produced globally, which will rise year after year as the world continues to emit greenhouse gases and depletes the global carbon budget. The social cost of carbon is generally an economic metric that provides an estimate of the net marginal damages caused by greenhouse gas emissions. As it is a net value, it takes into account both negative and positive impacts. Thus, quantification of the social cost of carbon results in a monetary value of future damages caused by the emission of one metric ton of carbon dioxide into the atmosphere, or the benefits of reducing one ton of carbon dioxide in a given year. This approach seeks to reflect the expected willingness of society to pay now to prevent current or future damage caused by climate change.

The social cost of carbon is estimated using integrated assessment modelling (IAM), the best-known methods being the Dynamic Integrated Climate-Economy (DICE) model (Nordhaus, 2010), the Climate Framework for Uncertainty, Negotiation and Distribution (FUND) (Anthoff and Tol, 2013a and 2013b), and the policy analysis of the greenhouse effect (PAGE) model (Hope, 2011). A more detailed explanation of these models is presented in table 13.

Table 13

Characteristics of the different models used to estimate the social cost of carbon

Model and latest version	Geographical areas	Gases	Sectors (impacts and damages)	Time range	Adaptation	Climate module used
PAGE (Hope, 2011; Kikstra and others, 2021; Yumashev, 2019; Yumashev and others, 2019) **PAGE09**	8 countries and regions: China, India, Russian Federation and the United States and Africa, European Union, Latin America and other OECD countries	Carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, sulfates, other greenhouse gases	Market, non-market, sea level rise and stochastic discontinuity	2008–2200 Annual modelling option	It is an exogenous variable, so it depends on policies developed rather than the state of the climate or capital	Representation of climate according to the IPCC *Fifth Assessment Report* (RCPs and SSPs)
DICE (Nordhaus, 2017 and 2018). **DICE 2016 R2**	Global	Carbon dioxide	Single damage function, which depends especially on the increase in global temperature	2015–2100	Implicitly represented in its parameters	Representation of climate according to the IPCC *Fifth Assessment Report* (RCPs and SSPs)
FUND (Waldhoff and others, 2014) **FUND 3.11**	16 countries and regions: Canada, China and United States and Central America, former Soviet Union, Middle East, North Africa, Small Island States, South America, South Asia, South-East Asia, Sub-Saharan Africa and Western urope	Carbon dioxide, methane, nitrous oxide, sulfur hexafluoride and aerosols	Agriculture, forestry, sea level rise, cardiovascular and respiratory disorders caused by temperature stress, malaria, dengue, energy consumption, water resources, unmanaged systems (ecosystems), diarrhoea and tropical and extratropical storms	1950–3000, annual modelling	Includes adaptation endogenously, as impacts depend on previous years	Representation of climate according to the IPCC *Fourth Assessment Report*

Source: Economic Commission for Latin America and the Caribbean (ECLAC), on the basis of C. Hope, "The PAGE09 Integrated Assessment Model: A Technical Description", *Working Paper Series*, No. 4/2011; J. Kikstra, "The social cost of carbon dioxide under climate-economy feedbacks and temperature variability", Environmental Research Letters, vol. 16, No. 9, Bristol, IOP Publishing, 2021; D. Yumashev, "PAGE-ICE integrated assessment models", Integrated Assessment Models and Other Climate Policy Tools, A. Diemer and others (eds.), Clermont-Ferrand, Editions Oeconomia, 2019; D. Yumashev and others, "Climate policy implications of nonlinear decline of Arctic land permafrost and other cryosphere elements", Nature Communications, vol. 10, Berlin, Springer, 2019; W. Nordhaus, "Revisiting the social cost of carbon", Proceedings of the National Academy of Sciences (PNAS), vol. 114, No. 7, Washington, D.C., National Academy of Sciences (NAS), 2017; "Evolution of modeling of the economics of global warming: changes in the DICE model, 1992–2017", Climatic Change, vol. 148, No. 4, Berlin, Springer, 2018; S. Waldhoff and others, "The marginal damage costs of different greenhouse gases: an application of FUND", Economics, vol. 8, No. 1, Berlin, De Gruyter, 2014; Intergovernmental Panel on Climate Change (IPCC), Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, R. Pachauri and L. Meyer (eds.), Geneva, 2014; Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, R. Pachauri and A. Reisinger (eds.), Geneva, 2007.

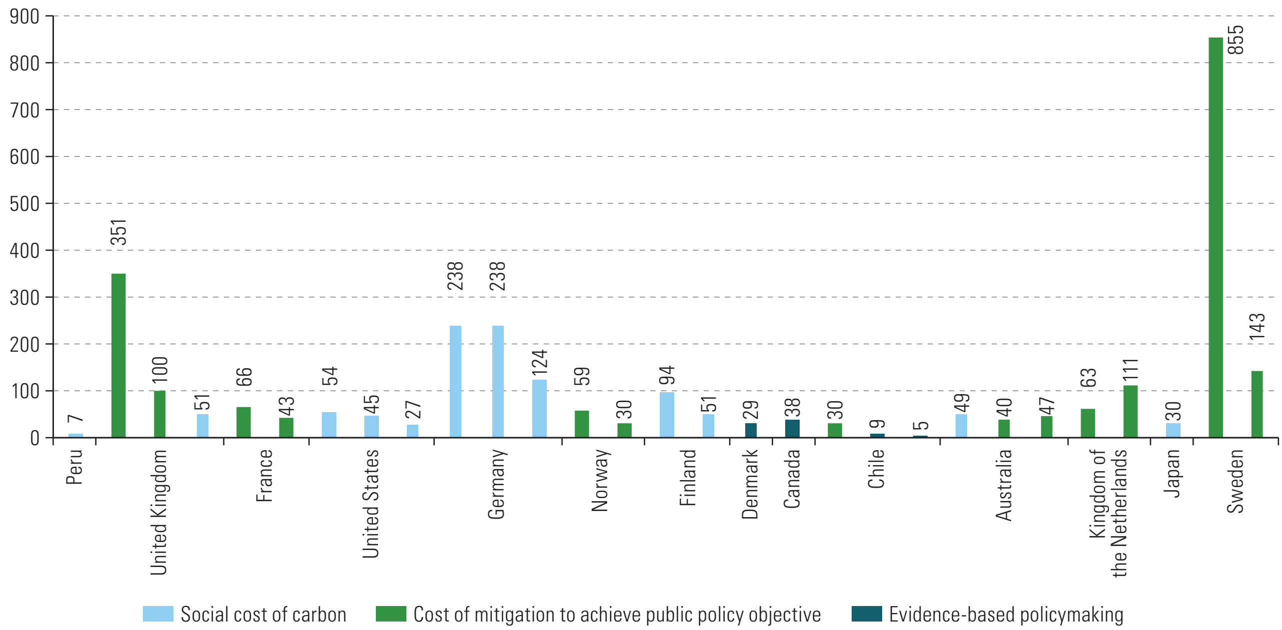
The main alternative to integrated assessment models for calculating the social price of carbon has been calculation of the abatement cost associated with a public policy goal. This is based on marginal abatement cost curves (MACCs) and a carbon budget associated with the goal. The approach simplifies information requirements, since the emission and mitigation cost models it calls for can be national; national models are simpler and depend on fewer assumptions about actions of other countries. In addition, they have the virtue of generating a price signal that is consistent with national mitigation targets (for example NDCs), promoting climate action in all public policies and initiatives assessed through the social price of carbon.

In addition to these methods, given the many national experiences of estimating social prices of carbon, evidence can be used by a country to set its social price of carbon. This can be done by selecting the same social price of carbon as another country, or using a value based on the scientific literature, recommendations from international organizations or carbon market prices. Figure 25 below shows estimates of the social price of carbon that have been made by countries using different methodologies.

Figure 25

Selected countries: national estimates of the social price of carbon

(Dollars at constant 2021 prices)



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

As part of the Social Price of Carbon in the Evaluation of Public Investment Projects in Latin America and the Caribbean initiative, ECLAC has provided technical support on estimating the social price of carbon to the national public investment systems of the countries of Latin America and the Caribbean. In 2022, the social price of carbon was estimated for the first time in the cases of Costa Rica, the Dominican Republic and Nicaragua, and estimates were made to update shadow prices for Chile and Peru (see table 14).

Table 14
Latin America and the Caribbean (5 countries): estimated social prices of carbon, 2022
(Dollars at constant 2021 prices/ton of CO_2eq)

Country	Estimation methodology	Estimated social price of carbon
Chile	Evidence-based policy definition, using a benchmark	46
Costa Rica	Evidence-based policy definition, using multi-criteria analysis	40
Dominican Republic	Social cost of carbon	26
Nicaragua	Social cost of carbon	19
Peru	Social cost of carbon	30

Source: Economic Commission for Latin America and the Caribbean (ECLAC), Social Price of Carbon in the Evaluation of Public Investment Projects in Latin America and the Caribbean initiative.
Note: These estimates are the result of coordinated work with the national public investment systems of the respective countries and are currently in the phase of capacity-building for the technical teams for implementation.

3. Including climate change in environmental impact assessments of projects

Since the 2010s, there have been growing efforts to adapt environmental impact assessment (EIA) processes to include the impacts of climate change on investment projects and vice versa, although they remain fledgling. The 2015 Paris Agreement, national climate action commitments and climate finance mechanisms have served as a basis for States to include the link between climate change and EIAs in legislation (for example in Canada, Germany, Spain, the United States, the United Kingdom and the countries of the European Union). In Latin America and the Caribbean, the Latin American Network of Environmental Impact Assessment Systems (REDLASEIA) and ECLAC are working on criteria for integration of climate change into the environmental impact assessment of investment projects in the following stages of the process (ECLAC, 2023b):

(i) Project description: the main aim is to reduce risks and make projects more resilient. To this end, preliminary feasibility studies are prepared, considering different design and location options for the investment project, as well as the project's contribution to greenhouse gas emissions.

(ii) Socioenvironmental baseline: this should factor in patterns in climate change and variability and address uncertainty over environmental factors, which were previously assessed in a static manner. The aim is to determine whether, as a result of climate change, areas that currently do not exhibit implementation risk for projects could become risk areas in the future.

(iii) Assessment: the main purpose of this stage is to effectively integrate potential risks and impacts related to climate change into assessments.

(iv) Environmental management plan: aims to incorporate appropriate adaptation and mitigation actions, using an adaptive environmental management approach in response to uncertainties.

D. Environmental democracy: a catalyst for informed and inclusive climate action

Education and public awareness campaigns on climate change and its effects, as well as informed public participation in the development of appropriate responses, are essential to a successful transition to low-carbon economies with the urgency required (article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) and article 12 of the Paris Agreement). The Regional Agreement on Access to Information, Public Participation and Justice in Environmental Matters in Latin America and the Caribbean (ECLAC, 2018b), known as the Escazú Agreement, contributes to strengthening environmental democracy in the region, which is key to achieving the necessary compacts so that mitigation and adaptation efforts are embraced by all sectors of society and are long-lasting. The Agreement also helps to ensure that the required transitions will be fair.

Its provisions include principles directly linked to climate action (principles of equality, non-discrimination, non-regression, progressiveness and the *pro persona* principle). The Escazú Agreement expressly sets out the obligation of each Party to guarantee the right of every person to live in a healthy environment and to sustainable development.

The Agreement establishes transparency obligations (production of and access to information), in accordance with the principle of maximum disclosure. Access is also guaranteed to available climate information on emissions and climate vulnerabilities, and to other information related to areas such as climate observations and risks associated with climate change. The Agreement also fosters proactive production and dissemination of climate information, from sources such as those related to carbon dioxide emissions, and development of updated environmental information systems that may include a list of contaminated areas, scientific reports and studies, and information from sources related to climate change. Furthermore, it encourages the keeping of records on pollutant release and transfer, covering air, water, soil and subsoil pollutants and subsoil, and materials and waste.

In a region that is highly vulnerable to extreme natural events, the Agreement contributes to disaster management through the obligation to disclose relevant information to take measures to prevent or limit possible damage. This is accompanied by a duty to develop and implement early warning systems.

The Agreement also boosts public participation in climate issues from a rights-based perspective, seeking to make it open and inclusive. This includes climate change and carbon-neutral policies, plans and strategies, and even the processes for preparing, updating and monitoring nationally determined contributions. The final two environmental rights are represented by strengthening of environmental justice and the protection of human rights defenders in environmental matters, consolidating the rule of law and institutional frameworks to improve environmental performance in the region.

Lastly, considering the inequity that lies beneath climate change in the region and the world, both in terms of its impacts and in capacities to adapt and respond, the special attention that the Escazú Agreement pays to people and groups in vulnerable situations is particularly important for a just transition. In short, the Escazú Agreement and Action for Climate Empowerment (Article 6 of UNFCCC) go hand in hand and their implementation will lay the technical foundations for the major transformations that are needed to address the challenge of climate change in the region.

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Climate change is increasingly evident and is having damaging repercussions. Latin America and the Caribbean is no exception, and is in fact one of the most vulnerable regions, with droughts, forest fires and extreme storms increasing in frequency and intensity. This is occurring amid the backdrop of low growth in the region, reflected in a decade of stagnation, that jeopardizes the progress made in terms of development and, above all, limits the countries' ability to improve the well-being of their populations in a sustainable manner.

At this crossroads, climate action offers an opportunity to boost growth and innovation, create jobs and better integrate countries of the region into the global economy. The investments, plans and policies required to tackle the climate crisis may also help to achieve economic and social goals.

This document outlines the overall economic impacts of climate change and describes regional mitigation and adaptation commitments. On that basis, an estimate is made of the required investments, examining the specific polices being developed in the region to enable them.

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