



UNDP LAC C19 PDS N°. 14B

Latin America and the Caribbean: Natural Wealth and Environmental Degradation in the XXI Century

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Abstract

*The Latin American and Caribbean region has exceptional natural wealth compared to other continents on the planet. At the same time, the social and economic processes of the region have also brought about processes of degradation of that natural capital that may put at risk, the possibility of a path of sustainable development for their countries. This document reports the situation of the most relevant indicators in terms of the wealth of existing ecosystems and their degradation processes. Alluding to the ancient taxonomy of the four elements, our review will take a tour of the land, water, air and energy in the region. We will compile the most up-to-date information to date on the state of terrestrial ecosystems and land uses, inland and coastal water resources, and air quality. Next, we will analyze the energy issue and its relationship with the emissions of gases associated with climate change, given the relevance of the issue for the future of the region and its contribution to global change. Finally, we conclude with a discussion on the possible ways forward in terms of public policy. This document is complemented by another entitled “**Lessons from COVID-19 for a sustainability agenda in Latin America & the Caribbean**” in this same series #COVID19 by UNDP-LAC.*



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Latin America and the Caribbean: Natural Wealth and Environmental Degradation in the XXI Century
July 2020

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Introduction to the series:

Evidence, Experience, and Pertinence in Search for Effective Policy Alternatives

The Covid-19 pandemic is one of the most serious challenges the world has faced in recent times. The total cost in terms of human lives is yet to unfold. Alongside the cost of lives and deep health crisis, the world is witnessing an economic downfold that will severely impact the wellbeing of large parts of the population in the years to come. Some of the measures that are currently being used to counteract the pandemic may impact our future lives in non-trivial ways. Understanding the association between different elements of the problem to broaden the policy space, with full awareness of the economic and social effects that they may bring, is the purpose of this series.

Thus far, the impossibility of targeted isolation of infected individuals and groups has led to policies of social distancing that impose a disproportionately high economic and social cost around the world. The combination of policies such as social distancing, lockdowns, and quarantines, imply a slowdown or even a complete stop in production and consumption activities for an uncertain period of time, crashing markets and potentially leading to the closure of businesses, sending millions of workers home. Labor, a key factor of production, has been quarantined in most sectors in the economy, borders have been closed and global value chains have been disrupted. Most estimates show a contraction of the level of output globally. For the Latin America and Caribbean region, the consensus forecasts are at -3 to -4%, and it is not until 2022 that the region is expected to go back to its pre-crisis output levels in scenarios that foresee a U-shaped crisis pattern. According to ECLAC, more than 30 million people could fall into poverty in the absence of active policies to protect or substitute income flows to vulnerable groups.

We face a crisis that requires unconventional responses. We are concerned about the level-effect: the impact of the crisis on the size of the economies and their capacity to recover growth after the shock. But we are equally concerned about the distributional impact of the shock. The crisis interacts with pre-existing heterogeneity in asset holdings, income-generation capacity, labor conditions, access to public services, and many other aspects

that make some individuals and households particularly vulnerable to an economic freeze of this kind. People in the informal markets, small and micro entrepreneurs, women in precarious employment conditions, historically excluded groups, such as indigenous and afro-descendants, must be at the center of the policy response.

UNDP, as the development agency of the United Nations, has a long tradition of accompanying policy-making in its design, implementation, monitoring and evaluation. It has a mandate to respond to changing circumstances, deploying its assets to support our member states in their pursuit of integrated solutions to complex problems. This series aims at drawing from UNDPs own experience and knowledge globally and from the expertise and capacity of our partner think tanks and academic institutions in Latin America and the Caribbean. It is an attempt to promote a collective reflection on the response to the Covid-19 health crisis and its economic and social effects on our societies. Timeliness is a must. Solutions that rely on evidence, experience, and reasoned policy intuition –coming from our rich history of policy engagement– are essential to guide this effort. This series also contributes to the integrated approach established by the UN reform and aspires to become an important input into the coherent response of the United Nations development system at the global, regional, and national levels.

Ben Bernanke, former Governor of the US Federal Reserve, reminds us in his book *The Courage to Act* that during crises, people are distinguished by those who act and those who fear to act. We hope this policy documents series will contribute to the public debate by providing timely and technically solid proposals to support the many who are taking decisive actions to protect the most vulnerable in our region.

Luis F. Lopez-Calva
United Nations Development Programme
Regional Director, Latin America and the Caribbean
New York, March 2020

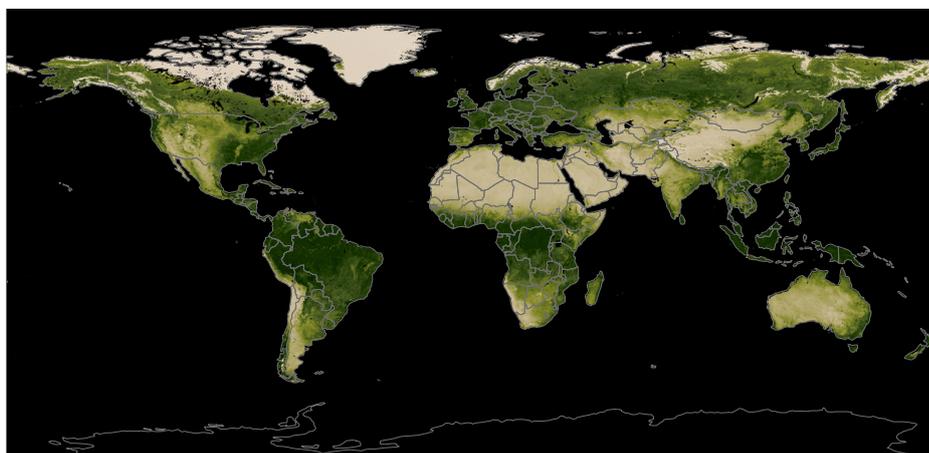


Parte I. Some relevant indicators on the state and change in ecosystems:

1. Land, Forests and Biodiversity

Latin America and the Caribbean host almost 60% of terrestrial life on the planet, along with a diverse marine and freshwater flora and fauna (UNEP, 2016). Figure 1 shows this clear and disproportionate concentration of natural coverage in this region, conformed by biomes ranging from wetlands and desert ecosystems to coastal, to tropical forests, and savanna grasslands.

■ Figure 1. Vegetation



Source: Normalized Difference Vegetation Index–Terra/MODIS (mayo, 2020).

This first image shows the relatively high level of forest density in the region in Central and South America and the Caribbean. The great Amazon basin is discernible, but this should not divert attention from the fact that another important part of the region has forest cover that, in contrast to the rest of the planet, accounts for green wealth and, therefore, of the multiple environmental services derived from it, in terms of water regulation, biodiversity conservation, and carbon capture and storage, among others.

Although large areas of the region remain in their natural state, there are also habitats that have been transformed in service to the needs of local, regional and global economies. A report from UNEP (2016) indicates that the main challenges in the region regarding biodiversity and the pressures it faces are:

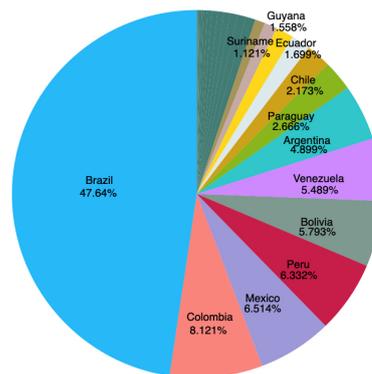
- The decrease in species and the high risks of extinction.
- Although the rate of loss of habitats in Latin America and the Caribbean has decreased, this degradation continues to be high.
- Accelerated economic growth and high rates of social inequality are putting pressure on the natural resources of the region.
- Extensive livestock farming has been one of the most important drivers of this degradation.
- The extraction of mineral and hydrocarbon resources has led to local devastation due to reduced coverage of forests, and water and land pollution.
- Air pollution, both local and transboundary, affect human and other species' health.
- The impacts of climate change such as ocean acidification accelerates the loss of life in coral reefs.



47.6% of the region's forest cover is in Brazil, followed by Colombia (8.1%) and Mexico (6.5%). Although the Amazon basin is of great importance in the forested area of the region, Paraguay, Chile and Argentina have almost 10% of the forest cover. The Andean forest of Patagonia, is found in the latter two countries, mainly in Chile.

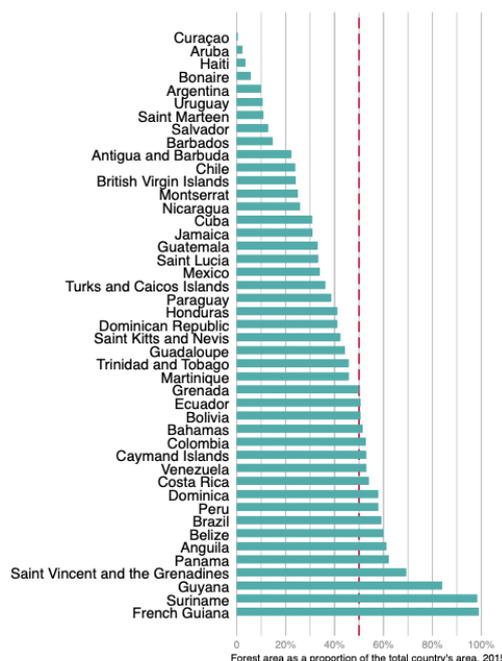
A look into the interior of the region also shows that a large part of the countries, both in the continental and insular areas of the region, are mainly forest areas. The great protectors of the Amazon basin, Brazil, Peru, Venezuela, Colombia, Bolivia, Ecuador, Suriname, Guyana and French Guiana, generally show a large percentage of forest area within their territory. The islands of the Caribbean and Central America do not share a large percentage of the forest area of the region relative to other countries, considering size. Even so, in many of these countries, a great part of their territory is forested area, and therefore the importance of their conservation, to provide ecosystem services in these smaller countries.

■ Figure 2. Distribution of forest cover in the region, 2017



Source: FAOSTATS (2020).

■ Figure 3. Forest area as a proportion of the total area in each country of Latin America and the Caribbean, 2015



Source: Our World in Data.



Unfortunately, the trends in terms of the percentage change in forest area do not display the best news for the region when compared to the rest of the world. Using 1990 as the base year, the strongest rate of forest-cover loss in the negative range is in Latin America and the Caribbean, followed by Sub-Saharan Africa¹.

■ Table 1. Changes in forest area between 1990 and 2016 by region

Region	Forest Area in 1990 (km ²)	Change in 2016
East Asia and the Pacific	6,280,253	2.24%
Europe and Central Asia	10,199,848	2.34%
Latin America and the Caribbean	10,242,342	-9.68%
Middle east and North Africa	199,293	16.47%
North America	6,507,240	1.02%
South Asia	789,187	5.84%
Sub-Saharan Africa	6,515,615	-6.14%

Source: Authors' calculation based on World Bank (2020).

Uses and Land Cover

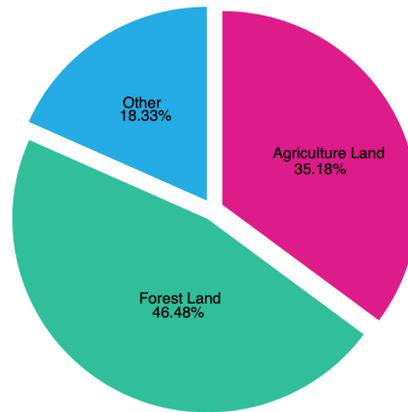
57% of the world's primary forests are found in Latin America and the Caribbean, which play an important role in the care of biodiversity and conservation. In countries like Ecuador, French Guiana and Venezuela, more than 80% of its forest area is primary forests. In fact, the vast majority of forests in the region are primary and/or have been naturally regenerated. As is well known, a significant fraction of greenhouse gas emissions in the region come from activities associated with land use (deforestation, livestock, agriculture, and the production and consumption of inputs to maintain them as fertilizers, agrochemicals, and fuels). According to FAO, the region contributes 17% of the total greenhouse gas emissions produced worldwide by agriculture, mainly due to emissions from the digestive systems of livestock (60%), manure (25%) and other chemical input activities associated with production, in addition to reducing forest cover that operate as carbon sequestrators.

Within the post-Covid-19 scenarios, it is plausible to think that, in the face of short-term limitations to international trade, due to greater sanitary controls and the reduction of different economic activities, the countries of the region will resort to the domestic market to meet the demand for primary goods in agricultural chains and the internal demand for food. In this sense, pressure on the agricultural frontier can threaten forested areas, unless measures are taken in this regard.

¹ The Middle East and North Africa region stands out for its positive change in that period, but we are talking about a forest cover that would be equivalent to 2% of the coverage of Latin America and the Caribbean. The countries of the Middle East and North African region have historically had very low forest cover.



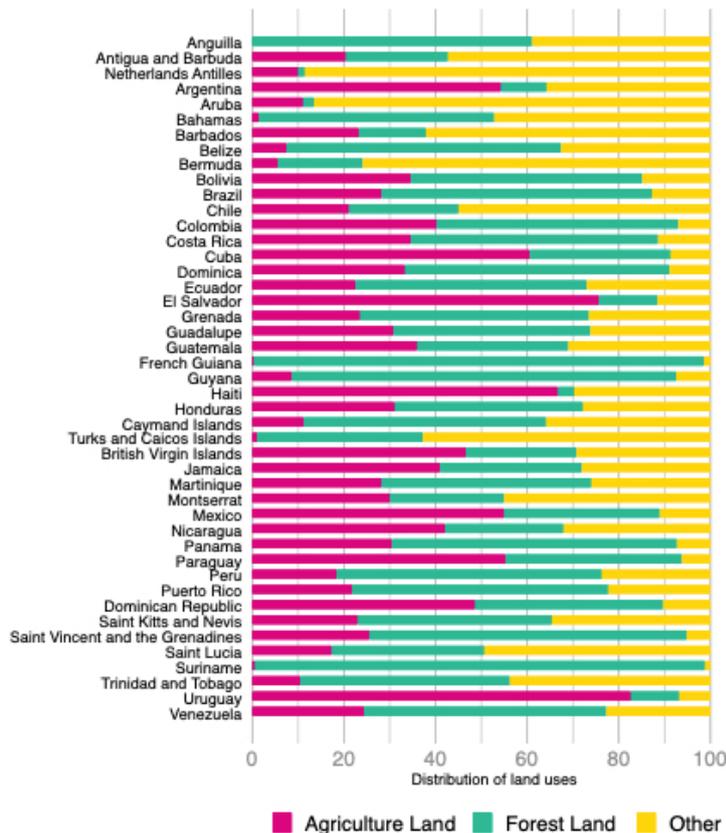
■ Figure 4. Distribution of land uses in Latin America and the Caribbean, 2017



Source: FAOSTATS (2020).

Land use in the region is mainly agricultural. However, given the growth of the urban population in the region, the expansion of cities can accelerate the change in land use and increase the climatic consequences mainly due to deforestation. The following figures show the distribution of land uses in each of the countries, as well as the distribution in each of the uses, both forest and agricultural, during 2017.

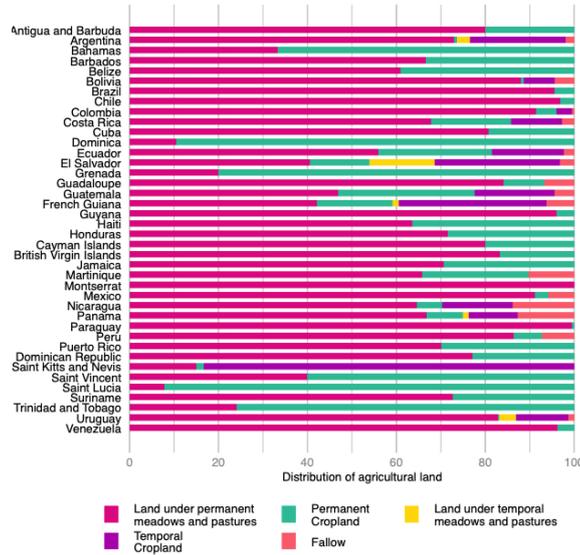
■ Figure 5. Distribution of land uses in the region by country, 2017



Source: FAOSTATS (2020).



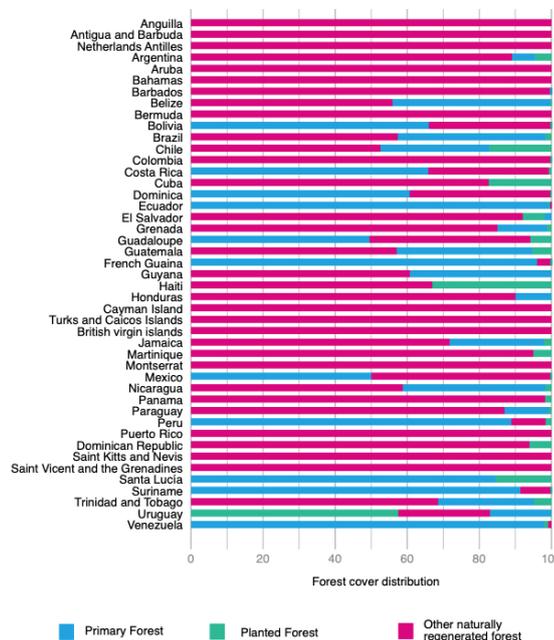
■ Figure 6. Distribution of agricultural land by country, 2017



Source: FAOSTATS (2020).

The importance of land use in forests derives from the ecosystem services that these offer by being the habitat of species, regulators of water cycles, carbon sequestration and storage, generators of pollinating processes, among others. Sustaining these services for the economy requires that the processes of recovery of forested areas are aimed at planting and reforestation of native species, in addition to the protection and conservation of existing primary forests. A significant part of these forest areas has had very low levels of human intervention, which allows them to host one of the greatest biological riches in the world. As aforementioned, the region has the most extensive primary forest on planet Earth, in the Amazon. However, only a fifth of this jungle still remains intact (Greenpeace, 2015). The following figures shows the distribution of forest area in each country according to the type of forests they have.

■ Figure 7. Forest cover distribution by country, 2017



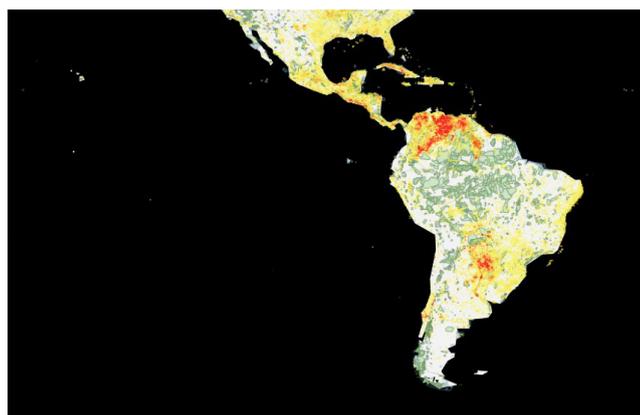
Source: FAOSTATS (2020).



The biological wealth of primary forests has been rapidly and irreversibly affected due to human intervention. In Latin America and the Caribbean, almost 9.68% of forested area in the region was lost in 1990. This depletion of forested area is linked to changes in land use, for activities related to the extractive industries, agriculture, livestock and urbanization.

Forest fires represent one of the main causes of deforestation concern. Between 2001 and 2018, 92 million hectares of forest cover were lost in the region. Of these, only 59% of deforestation occurred due to the exploitation of raw materials (GFW, 2018). The following map shows the wildfire alerts for the past month before the COVID-19 pandemic was declared. Unfortunately, the year 2020 has seen an increase in forest fires, mainly in the Amazon, due to the pressure of expansion activities of agriculture and logging, as we can see in the most recent sources of alerts on the following map.

■ Figure 8. Fire Hotspots², between February 9 and March 11, 2020



Source: VIIRS 375m – FIRMS (2020).

It is important to highlight that, during this first quarter of 2020, the region was in its wet season, which has prevented the fires from spreading on a large scale. However, in August 2019, forest fires in the Brazilian Amazon devastated an area equivalent to 4.2 million soccer stadiums (*Semana Sostenible*, 2019). These fires increase greenhouse gas emissions and affect rainfall patterns, extending dry seasons, affecting biodiversity, agriculture, and human health (Greenpeace, 2019). In particular, it has a high impact on ethnic communities, mainly indigenous ones, who not only protect and subsist from forests, but have a cultural, religious and social attachment to many of these spaces.

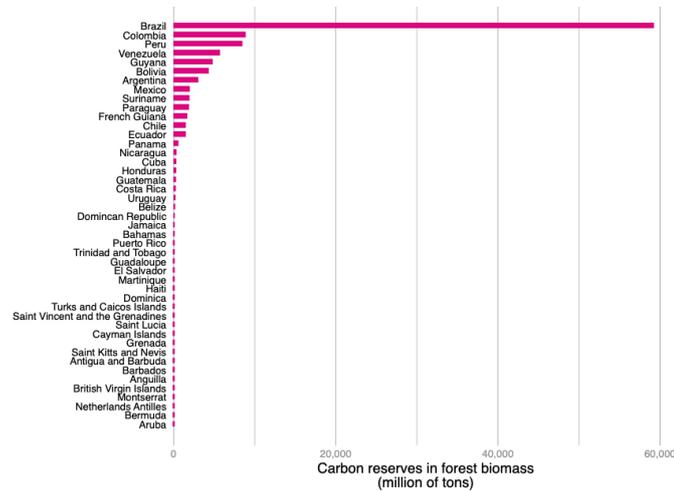
Emissions from Land Use

Land use, land use change and forestry is a sector of great importance for climate change mitigation. Given the growth of the region and the land use discussed above, greenhouse gas (GHG) emissions from this sector are a challenge for the region. In contrast to urbanization, broad forest areas are usually inhabited by ethnic communities that protect the area to which access by humans has been limited beyond the borders of each forested ecosystem. This care has also represented protection to carbon reserves within the forest biomass that, if exploited through deforestation, would accelerate the current climate change process on the planet. The following figure shows the carbon reserve stock in the forest biomass in each country, demonstrating the uneven distribution of those carbon reserves in very few countries.

² Fire hotspots are points where more than 100 fire alerts have been filed in the last month.



■ Figure 9. Carbon reserves in forest biomass by country, 2017



Source: FAOSTATS.

Thanks to the fact that a large proportion of the primary forests of the Amazon jungle and other forest areas in the region have remained intact, Latin America and the Caribbean have carbon sinks of global importance, in addition to the regulation and supply of water, and the conservation of biodiversity.

2. Water

The case of water, as a renewable resource and highly dependent on the state of conservation of ecosystems, is one of the contrasts in the region. Once again, there is a natural wealth higher than the average for the rest of the world, if we consider the water network in figure 10, and in turn, the most worrying trends associated with the pressure of economic activities on natural resources and the increasing migration to cities.

■ Figure 10. Map of the main rivers of the world

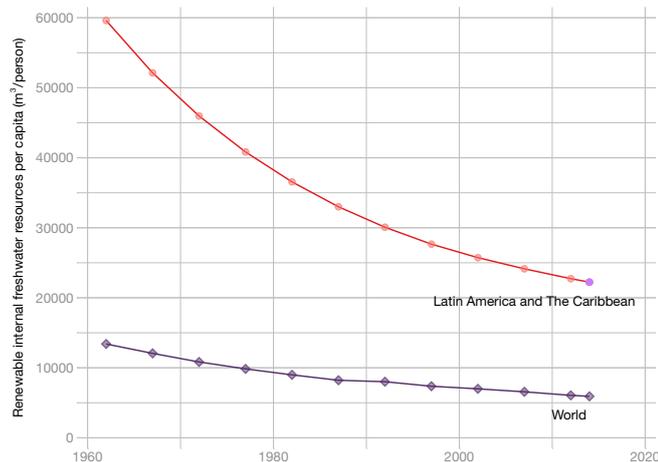


Source: Natural Earth Data

The following figure summarizes the estimates of freshwater stocks available in recent decades per inhabitant. The rate of savings, substantially higher for the region compared to the rest of the planet, raises concerns, taking into account the trend towards urbanization and the growing needs for drinking water for consumption, industry and agriculture. It is not a coincidence that this accelerated reduction in freshwater stock is associated with the accelerated growth of the population living in urban centers (see figure 14).



■ Figure 11. Renewable internal freshwater resources per capita (m³/person), 1962–2017.

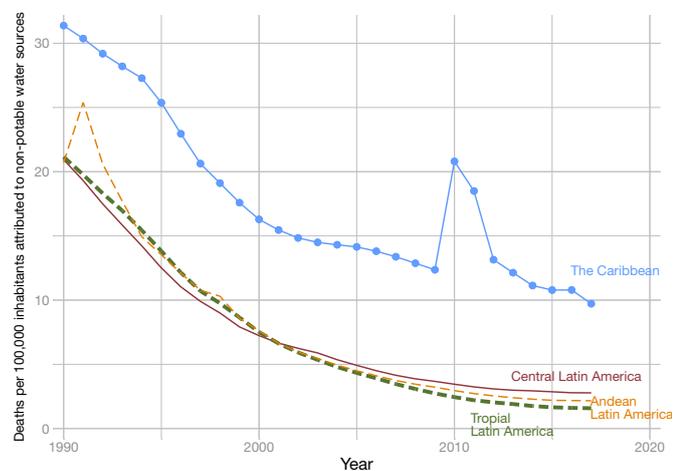


Source: Our World in Data.

The demand for water for different human activities is closely related to other factors that we have mentioned. The case of agriculture and livestock is one of them. On the one hand, the production of meat and products for fattening animals generate a significant demand for water, in a region with a high supply and demand for these products.

The provision of potable water for the population is vital, in order to be able to attack the health challenges of the most vulnerable populations. Paradoxically, the abundance of water available in the region contrasts with challenges still to be resolved in terms of quality. Deaths from diseases associated with non-potable water, although they have been decreasing worldwide, continue to be a challenge, especially in the Caribbean region where high morbidity and mortality rates continue to occur due to lack of access to potable water.

■ Figure 12. Deaths per 100,000 inhabitants attributed to non-potable water sources.



Source: Our World in Data.



Coastal Systems

The oceans that surround the region provide great ecological benefits, but at the same time they represent great economic gains either from food or eco-tourism (UNEP, 2018). Marine protected areas are one of the best ways to protect the health of the oceans from overfishing, pollution and acidification, in addition to providing sustenance to the human populations that live on the coasts. The region has a coastline along the Caribbean, Atlantic, and Pacific that makes it privileged to benefit from the great marine currents. According to Guarderas et.al (2008) the region has more than 700 marine protected areas that cover about 1.5% of the coastal waters and coastal platform in more than 300,000 square kilometers. When evaluating the distribution of these, the authors highlight a very low representativeness of the marine ecosystems of the Pacific and South Atlantic in South America. According to goal 11-ACH1³ (CBD, 2018), by 2020, 10% of coastal and marine areas must have equitable and efficient conservation mechanisms in ecosystem terms. In particular, those of greater importance for biodiversity and ecological services. In 2018, countries such as Brazil, Colombia, Mexico, and Peru had already met their national goal, while other countries such as Suriname, Panama, Guatemala, and Saint Lucia had insufficient conservation goals (CBD, 2018).

Coastal systems are experiencing the consequences of climate change. According to the IPCC (2007), the main impacts of this phenomenon on the coasts are related to the acidification of the oceans, the increase in sea temperature and sea level. The oceans are a source of food, they regulate the climate, they produce most of the oxygen consumed on the planet and they absorb a third of the carbon dioxide that we generate (UNEP, 2018). Although several countries in the region are legislating the protection of these, it is still necessary that several follow this path and that the restrictions and protection measures implemented are working effectively.

Some of these irreversible impacts can already be seen in the largest and most complex coral reefs on the continent, the Abrolhos archipelagos in Brazil; the archipelagos of the Rosario Islands, San Bernardo, San Andrés, Providencia and Santa Marta in Colombia, and the archipelagos of Blanquilla Island, Los Roques National Park, Morrocoy National Park and Mochima National Park in Venezuela (NOAA, 2005).

Plastic Pollution

Although the mass production of plastic begins in the 1950s, today more than nine million tons of plastic waste ends up in the oceans every year. The use of plastic has become normalized in the lifestyle of human beings, which seems unrecognizable to a life before the Second World War where they were not so widely used. During their production, chemical substances are added to plastics, to improve their functionality but at the same time making them endure without being biodegraded for hundreds of years.

In 2010, countries such as Guyana, Saint Lucia, Saint Kitts and Nevis, Antigua and Barbuda and Barbados, produced more than 0.5kg per capita of plastic waste per year. In that same year, Latin America and the Caribbean produced a little more than 7.2% of the plastic that was not properly managed. A plastic management policy, in particular for single-use plastic, is necessary for the region since the Caribbean Sea is the second most plastic-contaminated sea in the world. Being pioneers in the region, the islands of Antigua and Barbuda have set the standard for various countries such as Argentina, Barbados, Brazil, Chile, Colombia, Costa Rica, the Dominican Republic, Ecuador, Granada, Guyana, Honduras, Panama, Peru, Santa Lucia and Uruguay to be a part of the Clean Oceans strategy and have mechanisms to limit their plastic waste with policies that prohibit them completely or tax their use (UNEP, 2018).

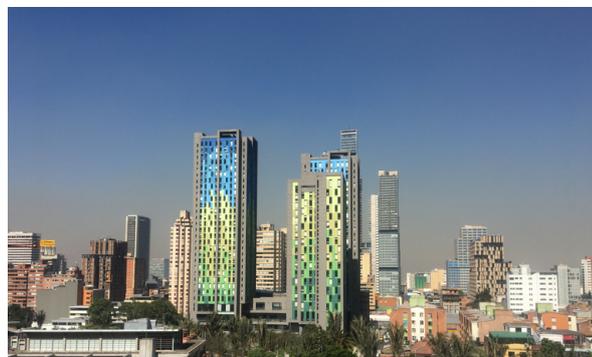
³ Goal 11 – ACHI also includes that 17% of inland waters must have these protection mechanisms.



3. Air

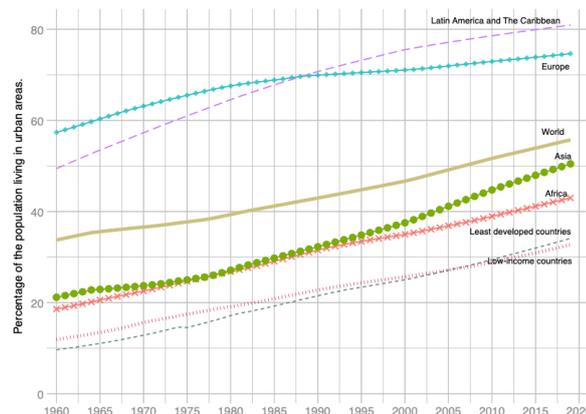
Air quality has become one of the symbolic aspects of the "respite" that the COVID-19 has given to people's daily lives. This image of Bogotá with its strip of pollution, days before the beginning of the quarantine in this city, is just an example of many other cities in the region that, with the increase in urbanization and the use of cargo and passenger transport – main source of emissions, have seen new images of cleaner air.

■ Figure 13. Air in downtown Bogotá, February 5, 2020 at 10am.



In this last century, the process of economic and demographic transition in the region led to 80% of the region's population moving to live in urban areas. This process has been much more accelerated in Latin America and the Caribbean than in other regions of the world. This movement from the countryside to the city also implies that economic activities in these areas also increase, creating pressure on air quality due to the need to provide public services, such as mass transportation, drinking water and energy, in cities.

■ Figure 14. Percentage of the population living in urban areas.



Source: Our World in Data

The air quality monitoring systems in these cities today allow measurements to be made day by day and to assess what happens throughout the year, given that different climatic and geographical aspects make each city have its own history and conditions that determine the presence of pollutants. One of the most common indicators is the concentration of particulate matter (PM2.5 and PM 10). Based on these sources of daily monitoring of PM2.5, we constructed these time series from the medians of all daily measurements for capital cities where measurement systems



exist and compared the time series between 2019 and 2020. We see that, based on public health criteria, during an important part of the year these cities⁴ present “harmful” air quality conditions to sensitive groups and “very harmful” to the entire population according to parameters of the Environmental Protection Agency⁵ (EPA, 2020) and the WHO. This data, as can be seen in the following figures, is especially worrying in the case of PM2.5, this being even more important to respiratory problems than PM10. Thanks to the possibility of obtaining daily measurement data during the pandemic, in section III we will be able to analyze the changes in these levels of pollution attributable to the change in the activities of the economy and citizens.

■ Figure 15. Median PM2.5 daily concentration during 2019 and early 2020



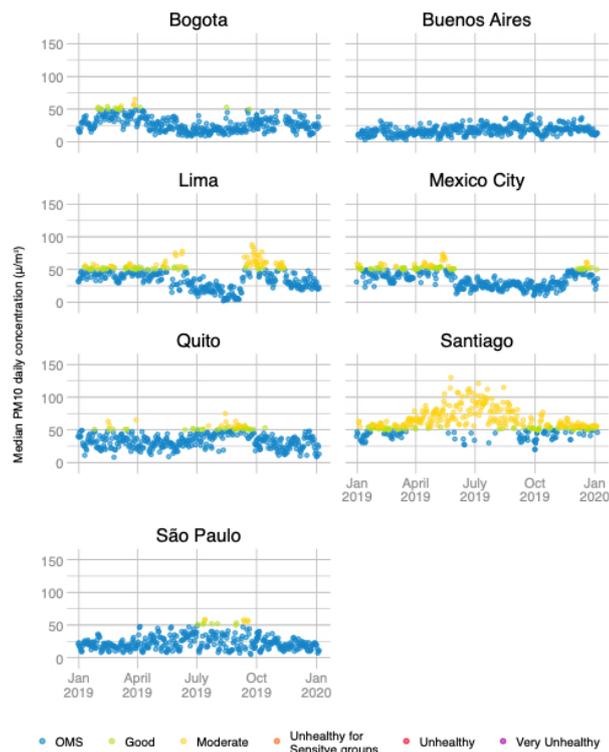
Source: Authors, from the World Air Quality Index.

⁴ The data for Guatemala City and San José are only available as of December 4 and 5, 2019 respectively. For Willemstad there is no information available as of July 2019.

⁵ See appendix 2



■ Figure 16. Median PM10 daily concentration during 2019



Source: World Air Quality Index.

Air pollution is one of the challenges in the region. Regionally, the transportation of merchandise and urban passengers are based on primary solutions. In addition, the growth of landfills in cities, absent from public policies, are a source of methane emissions and large amounts of fine particles due to fires, accidental or intentional. These two factors are the main sources of air pollution in urban areas. Together with the burning of crops and forests in areas other than urban areas, that due to the winds ultimately reach the cities.

As aforementioned, transportation is one of the main causes of air pollution. Most countries in the region do not have a regulation on fuel efficiency standards, vehicle emissions or fuel quality (NRDC, 2014), which is necessary for a clean transportation sector. In a region with growth of urban areas and the automotive fleet, it is necessary to control atmospheric pollution, both for the quality of life of city dwellers and to ease the burden on the health system

4. Energy and Climate Change

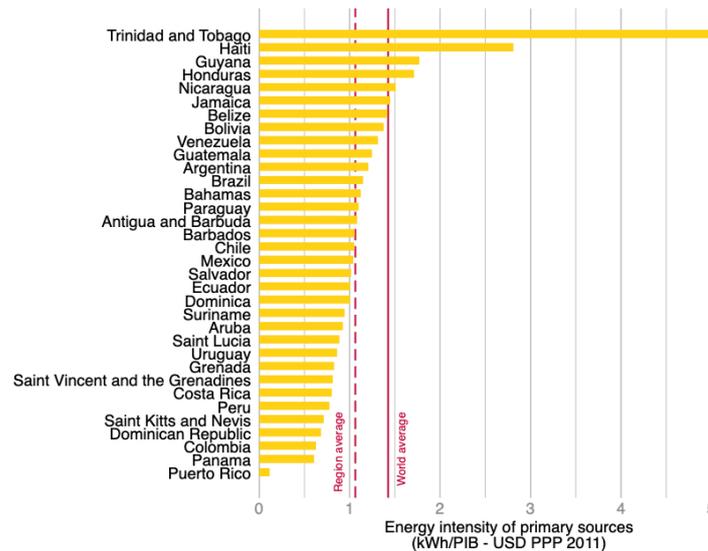
Latin America and the Caribbean is the most efficient region in the world when it comes to the use of energy. The vast majority of countries in the region have a low level of energy intensity⁶ from primary sources. In the region, 1.06 kWh is needed to produce one dollar of GDP. In fact, it has an advantage of 0.36 kWh/GDP⁷ with respect to the world average. As the following figure shows, most countries in the region have a low level of energy intensity.

⁶ Energy intensity is an indicator of energy efficiency. This indicator captures the amount of energy required to produce one dollar of GDP. The higher the indicator, the more expensive the conversion of energy into wealth.

⁷ GDP is calculated at 2011 USD PPP.



■ Figure 17. Energy intensity of primary sources in the countries of the region

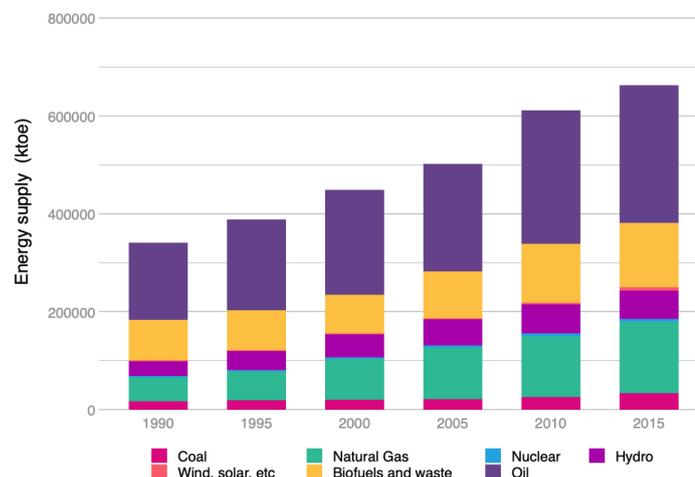


Source: Our World in Data.

Puerto Rico is the world leader in energy efficiency and, along with 12 other countries in the region, needs less than 1 kWh to produce a dollar of wealth. The region's energy efficiency is such that just over 80% of countries are below the world average in energy intensity. However, two of the countries at the extremes of the distribution of per capita income in the region, Haiti and Trinidad and Tobago, manage to far exceed the energy intensity rate of the region and the world.

On the other hand, the total energy supply in the region by primary sources has grown 94% between 1990 and 2015, largely driven by orientation strategies of these economies during the end of the last century and its beginning towards primary sectors, while deindustrialization occurred.

■ Figure 18. Energy intensity of primary sources in the countries of the region

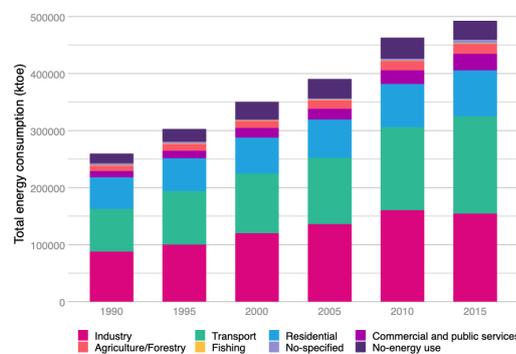


Source: IEA (2020).



On the other hand, Latin America and the Caribbean have played an important role in the generation of renewable energy sources. Currently, more than a quarter of its primary energy sources are renewable, more than double the world average. According to the IRENA report (2019), more than 200 GWh are produced in the region by renewable sources, mainly large-scale hydroelectric and biomass, and 10 GWh by solar, wind and geothermal energy. Likewise, the report also indicates that the region has made large investments, especially in the diversification of renewable⁸ energy sources. This managed to position two countries in the region among the ten largest renewable energy markets in the world.

■ Figure 19. Total energy consumption in the region by sector between 1990 and 2015



Source: IEA (2020). No energy use refers to other uses for petroleum products such as white gasoline, paraffin, lubricants, and bitumen, as well as other uses for coal products.

The sector that uses energy the most in the region is transportation (34.61%), followed by industry (31.40%) and residential (16.36%). These three sectors represent more than 80% of the region's energy consumption and is around 405 thousand Ktoe. While the commercial and public services sector represents only 5.91% of energy consumption, in 2015 it is the sector whose consumption rate has grown the most, being 2.6 times larger than in 1990. Likewise, the transport sector has duplicated, having a growth rate of almost 130% from the 1990s to 2015. In fact, energy consumption in the region grew at a rate of 175.8% while the population growth rate of the region has been 45.35%.

According to IDB calculations (2013), the region's energy potential is 22 times the estimated energy demand for 2050. Though hydroelectric energy will continue to lead energy production, by 2050 16% would come from wind energy, terrestrial and mainly marine; 46% of photovoltaic solar energy, and 21% of CSP solar energy. Although the region has a high potential for renewable energy generation, wind, solar and water resources are variable with natural and, above all, seasonal phenomena. In addition to water reservoirs, there are still no technologies that store large amounts of solar heat or electricity at costs that justify the technological transition⁹. This means that these renewable sources cannot supply the region's demand throughout the year. Sources such as bioenergy are a complementary alternative for the region's energy supply. Countries like Brazil have been pioneers in the production of biofuels for the transport sector, made from sugar cane. Bioenergy is not only produced from sugarcane, but also from other agricultural products, such as soybeans and corn, and from waste residues and crops. This sector could represent a profitable source of caloric energy and contribute to leveling out other variable renewable sources as well as being a generation of employment in rural areas of Latin America.

⁸ Between 2010 and 2015, total investment in renewable energy generation in the region reached nearly USD 120 billion. Only in the latter, 6% of the world's renewable energy investments was made in Latin America and the Caribbean (IRENA, 2019)

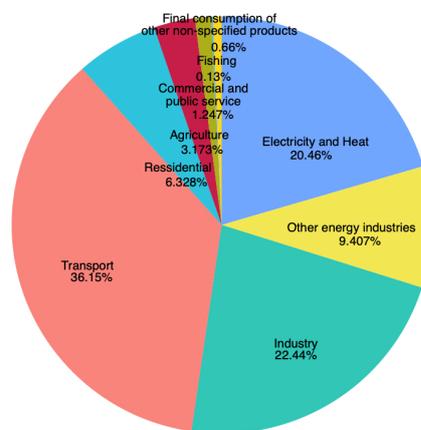
⁹ Today there are energy accumulators or batteries that store chemical energy but their storage capacity was limited to small amounts of energy.



Emissions from Energy Consumption

During 2015, the energy consumption in the region produced 1208 Mt CO₂ (IEA, 2020). Of which 36.15% came from the transport sector, 22.44% from industry and 20.46% from electricity and heating production. The following figure shows the distribution of CO₂ emissions in energy consumption by sector in Latin America and the Caribbean.

■ Figure 20. CO₂ emissions in energy consumption by sector, 2015



Source: IEA (2020).

Emissions from energy consumption have grown by 107% compared to 1990. This growth has been led mainly by the electricity and heating (224.5%) and transport (116.6%) sectors, which implies a huge challenge in the transition of energy sources to achieve global goals related to climate change.

Currently, technological progress has meant that the prices of clean and/or renewable technologies, such as wind and solar energy, have decreased while their efficiency and productivity have increased. As aforementioned, the region has an advantage in energy efficiency from primary sources and, some countries are world-leaders on the production of biofuels. This is why a push that achieves a comparative advantage over clean sectors can be decisive, for example, to ensure the future of biofuels in the region and achieve the energy transition¹⁰.

Other Energy Alternatives

The world and the region are moving in search of clean energy, one of them being geothermal energy with high potentials at lower emission levels. This type of energy is obtained through the heat of the interior of the earth (IRENA, 2019) and can generate a reliable base load for 24 hours a day, seven days a week, during the twelve months of the year (ESMAP, 2016). This is a more viable option for generating electricity at a lower cost than fossil fuels, particularly if environmental impacts are taken into account. Furthermore, its production function helps stabilize the cost of energy since it is not subject to the volatility of international prices of raw materials such as oil and coal (ESMAP, 2016).

According to the Association for the Development of Geothermal Energy, Latin America and the Caribbean has the potential to produce 70GW of this type of energy (IDB, 2014). Basically, every country on the Pacific coast of the region, from Mexico to Chile, has enough potential resources to develop geothermal projects. In fact, Mexico is in the top 5 producers of this type of energy worldwide (IRENA, 2019) and several Central American countries, such as

¹⁰ See more in León y Cárdenas (2020).



El Salvador and Costa Rica, cover a large part of their electricity demands thanks to geothermal energy (ESMPA, 2016). Currently, the island of Guadalupe currently produces 15MW and in South America, there is only one project in Argentina that produces 0.67MW.

Despite its advantages, geothermal energy has encountered several obstacles, while trying to be implemented. According to ESMAP (2016), only 15% of known global geothermal reserves are being exploited. One of the reasons for this is the high risk perceived during the initial stages of development of these resources. Well, during the exploration phase and the commencement of drilling, the uncertainty regarding the capacity of the resource is very high, which is not very attractive for the mobilization of private capital (ESMAP, 2016). In particular, the exploratory phase is even more delicate since most of the suitable areas for geothermal development are Green Fields, that is, virgin fields that need more investment to be developed from scratch (ESMAP, 2016).

Although geothermal energy appears to be a very attractive renewable energy source for Latin America and the Caribbean, there are a few considerations to keep in mind. In particular, mega works such as hydroelectric projects in the region have represented high environmental costs that are neither taken into account when being formulated, nor are they compensated when they produce and drastically affect the environment and its surrounding communities (Moran et al., 2018). Geothermal plants can represent a high environmental cost if their management is not suitable. These costs include micro-earthquakes, sulfuric acid emission, contamination of water sources, deterioration of the landscape and even an increase in the accidental emission of greenhouse gases that are contained below the earth's surface (UCUSA, 2013).

Another important alternative is nuclear energy. One percent of electricity consumption in Latin America and the Caribbean is supplied by this type of energy (IDB, 2013). Despite the fact that this source presents an opportunity to supply the growing consumption of electricity by reducing greenhouse gas emissions, there is a controversy around the use or not of this energy source based on the safety of nuclear power plants, the management of radioactive waste generated and the increase in nuclear weapons. These two production alternatives in the region follow the recommendations of the IPCC (2007) on the need to use low-carbon energy sources, such as renewable energy and nuclear energy.

Greenhouse Gas (GHG) Emissions and Climate Change

On April 16, 2020, the concentration of CO₂ in the atmosphere reached 413 particles per million. Exceeding 450 ppm can lead to a warming of the Earth's surface of at least 2 degrees Celsius (Stern, 2005), an anomaly that can trigger harmful and irreversible changes in the planet's climate (IPCC, 2014). Faced with this threat, the United Nations Framework Convention on Climate Change established the objective of "stabilizing GHG concentrations (...) to achieve a sufficient period of time for ecosystems to adapt naturally to climate change"¹¹ (UNFCCC, 1994). In search of this time frame, 96 countries committed to reducing their GHG emissions to achieve these global goals.

¹¹ Authors' translation.



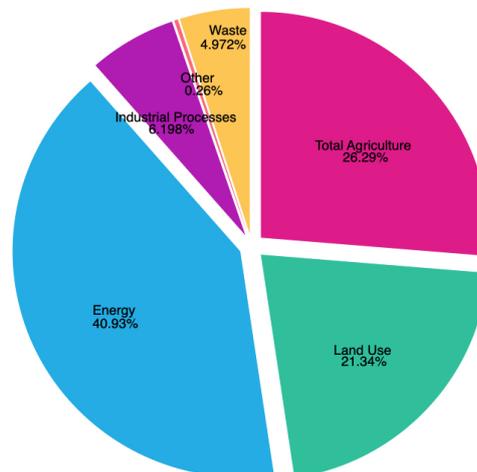
■ Table 2. Global CO₂ emissions by region, 2017

Region	% of world population	% of CO ₂ emissions by production	% of CO ₂ emissions by consumption
North America	5%	17%	19%
Europe	10%	16%	18%
Latin America and The Caribbean	9%	6%	6%
Asia	60%	56%	52%
Africa	16%	4%	3%
Oceania	0,50%	1,30%	1,30%

Source: Our World in Data.

The participation of Latin America and the Caribbean seems not to be very alarming compared to that of other regions of the world, but given the growth processes and the sectors of the region, it is expected that the growth of GHG emissions will increase in the coming years, especially with accelerated urbanization trends, on the one hand, and pressure on forest reserves, especially in the Amazon. Although the participation of the region is low, in order to achieve the climate goals, a drastic change is needed in the current path of emissions of all the regions. Most of the region's emissions come from the energy sector, followed by agriculture and land use, and industrial processes. Figure 22 shows the distribution of GHG emissions in the region by sector.

■ Figure 21. Distribution of GHG emissions by sector in Latin America and the Caribbean, 2017

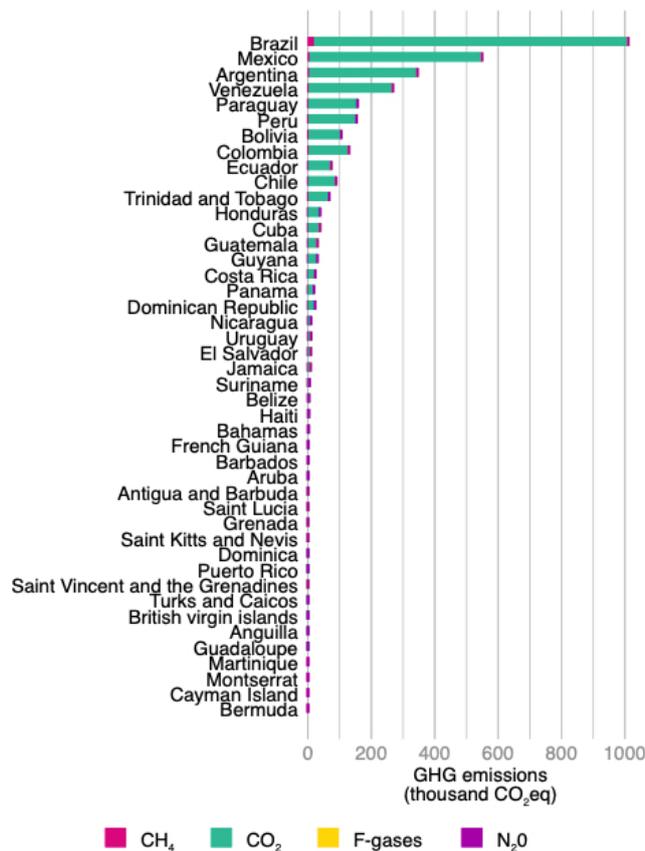


Source: FAOSTAT, 2017.

In contrast to the rest of the world, in Latin America and the Caribbean, GHG emissions are mainly produced by the agricultural sector, land uses. Although CO₂ is the most produced gas in the region, it is important to make efforts to reduce methane emissions since its impact on global warming is greater. The following figure shows the GHG emissions in each of the countries in the region where the greatest challenges in reducing emissions are in countries such as Brazil, Mexico, Argentina, Venezuela and Paraguay.



■ Figure 22. Emissions in Latin America and the Caribbean defined by gases and country, 2017



Source: FAOSTAT, 2020.

Unless immediate drastic actions are taken, a global warming of 2°C seems inevitable following the current trajectory. According to Vergara et al. (2013), this increase in the temperature of the Earth's surface represents physical risks that affect the region mainly in the following ways:

- Agricultural activities by affecting soil moisture and changes in rainfall patterns.
- The coastal and marine areas given the increase in sea levels, the warming of the surface temperature and the increase in the frequency of extreme weather events.
- Areas with high exposure to tropical vector diseases given the increase in temperature and the increase in the weather.
- The Andean glaciers given the warming.
- Hydrological basins due to changes in rainfall patterns.
- The rainforest.
- The integrity of ecosystems and biodiversity.

Without adaptation measures, these impacts will have a significant economic and social impact. By 2050, the main impacts of global warming may cost between 1.8 and 2.4% of the region's GDP. The following table shows the estimated annual costs of the main damages and impacts of climate change in the region.



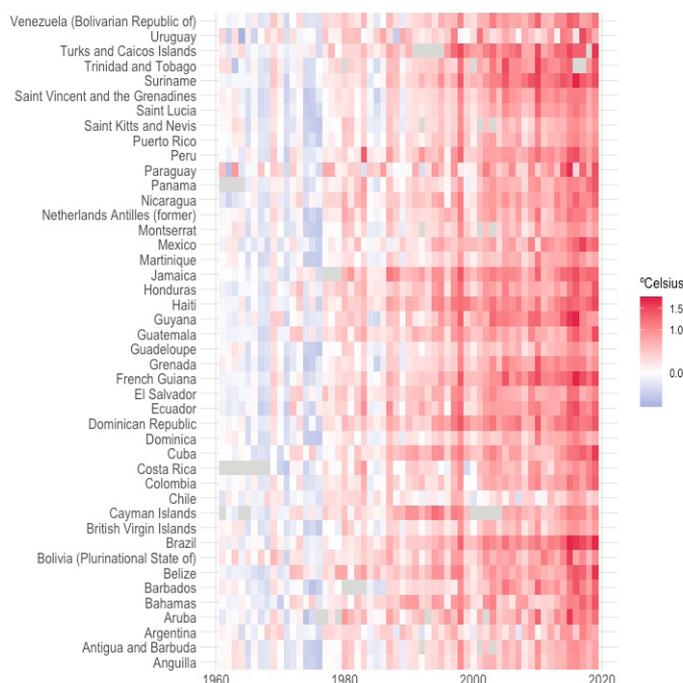
■ **Table 3.** Estimated annual costs of major damages and impacts of climate change after 2050 for the region

Impact	Region mainly impacted	Estimated annual costs (US \$ trillion in 2005 prices)
Loss due to decrease in net exports of agricultural products.	Latin America and the Caribbean	26–44
Sea level rise (1 meter)	Latin America and the Caribbean	22
Coral bleaching	The Caribbean	8–11
Increases in the intensity and frequency of extreme weather events	CARICOM Gulf Coast of Mexico, Central America and the Caribbean	5
Increases in the incidence of diarrhea and malnutrition	Latin America and the Caribbean	1
Loss of the Amazon	Latin America	4–8
Glacier retreat	Peru	1
Water power generation	Brazil	18
Estimated total annual costs		85–110 (1.8–2.4% of GDP)

Source: Vergara et al. (2013).

In 2019, the temperature of the Earth's surface had reached 0.98°C above pre-industrial levels. Following patterns, the average temperature on the land surface of all countries in the region during 2019 was above pre-industrial levels. It is worth highlighting the case of countries such as Brazil, Belize, Cuba, Haiti, French Guiana and, the Turks and Caicos are closer to the 2°C limit and, probably the closer you get, the faster the aforementioned impacts will be felt. The following figure shows this change in temperature from pre-industrial levels for each of the countries in the region in 1990 and 2019.

■ **Figure 23.** Change in land surface temperature above pre-industrial levels between 1961 and 2019



Source: FAOSTATS (2020).



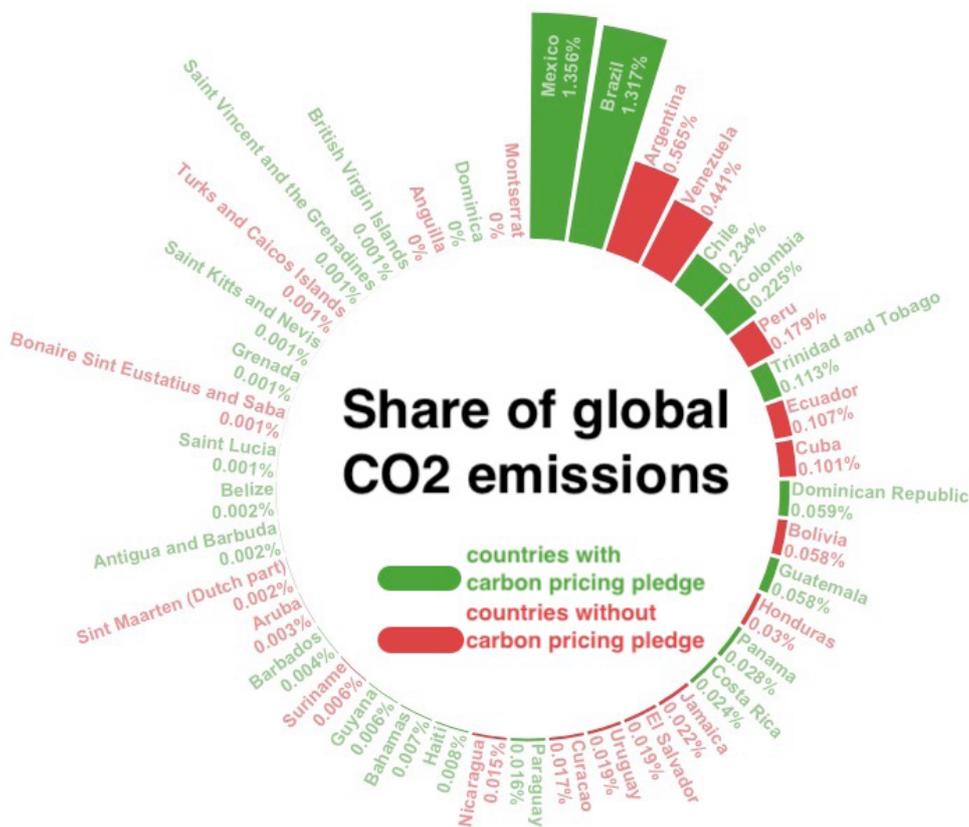
The social and environmental costs of a 2°C rise in land surface temperature above pre-industrial levels will be very high. Many countries in the region have already exceeded 1°C. Although several of the impacts of climate change are already manifesting, preventing the temperature from continuing to rise is crucial for the region. This is why Latin America and the Caribbean are part of the agreements that seek to limit this warming. The following section outlines the region's participation in the Paris Agreement and the current status of some of the actions taken by countries to mitigate climate change.

Carbon pricing

In the Paris Agreement, the signatory parties committed to transform their growth and development paths in order to reduce GHG emissions and thus limit global warming. This agreement asks countries to communicate and outlines their contributions to the climate crisis. One of the instruments that was most emphasized during the COP21 was the price of carbon. This tool seeks to put a price on the externalities caused by GHG emissions.

The following figure shows the participation of each of the countries in the region, in terms of total global CO₂ emissions and their commitment to use a carbon price mechanism to reduce their impact.

■ **Figure 24.** Share of global CO₂ emissions by country in Latin America and the Caribbean according to their commitment to the price of carbon, 2017



Source: Our World in Data (2017) and NDC Registry (2020).



In 2017, the region produced 5.047% of the world's CO₂ emissions. According to the Intended Nationally Determined Contributions Register (INDC), 68.75% of the countries in the region had indicated their intention to use a carbon price market instrument to decrease their GHG emissions. On the other hand, 10 countries in the region did not commit to using a market instrument such as the carbon price to achieve a reduction in their emissions. These countries include Argentina and Venezuela, which together sum up to just over 1% of global emissions. However, five years after the Agreement was signed, only 4 countries in the region have a price mechanism. The following is a brief description of the state of carbon prices in the region.

Argentina:

- GHG emissions (2016): 482.08 MtCO₂e.
- Policies implemented: *Impuesto al dióxido de carbono* (carbon dioxide tax)¹² on January 1, 2019 on most fossil fuels
- Percentage of emissions covered by the jurisdiction: 20%.
- Price: 6 USD¹³/tCO₂.
- Others:
 - i. As stated in its INDC (2015), Argentina had not committed to implement a carbon price instrument.
 - ii. The resources collected from this tax are not destined neither totally, nor partially, to finance funds or incentives that promote clean technologies or that counteract the negative environmental externalities of the use of fossil fuels.
 - iii. The carbon tax rate is based on the local currency. At the time it was implemented it was equivalent to USD 10/tCO₂. Given the devaluation of the Argentine currency, the rate is equivalent to USD 6/tCO₂.

Chile:

- GHG emissions (2016): 3.74 MtCO₂e.
- Policies implemented: *Impuesto destinado a gravar las emisiones del aire de compuestos contaminantes* (tax intended to tax air emissions of polluting compounds)¹⁴ from 2017 on all fossil fuels mainly in the industry and energy sectors.
- Percentage of emissions covered by the jurisdiction: 39%.
- Carbon price: USD 5/tCO₂.

Colombia:

- GHG emissions (2016): 232 MtCO₂e.
- Policies implemented: *Impuesto nacional al carbono* (national carbon tax)¹⁵ on all fossil fuels in all sectors except for natural gas consumers who are not in the petrochemicals and refineries sector, and carbon-neutral fossil fuel consumers.
- Percentage of emissions covered by the jurisdiction: 24%.
- Carbon price: USD 5/tCO₂.

Mexico:

- GHG emissions (2016): 688.38 MtCO₂e.
- Policies implemented: (i) Tax¹⁶ on additional CO₂ emissions from all fossil fuels on the production of natural gas emissions.

¹² Official name according to Law 27430 of 2017 (Ministry of Justice of human rights in Argentina, 2017).

¹³ Price as of April 1, 2019 (World Bank, 2020).

¹⁴ Official name according to Law 20780 (Ministry of Finance of Chile, 2014).

¹⁵ Official name according to Law 1819 of 2016. (Congress of the Republic of Colombia, 2016).

¹⁶ See more Secretary of the Government of Mexico (2016).



- Percentage of emissions covered by the jurisdiction: 46%.
- Carbon price: 3% on the price of fossil fuels. So, the carbon price is between 0.38 and 3 USD/tCO₂.
- Policies implemented: (ii) Pilot of the emissions trading system¹⁷ that began to operate from January 1, 2020. This pilot covers the energy, industry, oil and gas sectors. Mexico expects its thorough application by 2023.
- Percentage of emissions covered by the jurisdiction: 37%.
- GHG limit: 271 MtCO₂e.

Comparably, French Guiana, Martinique, Guadeloupe and Saint Bartholomew are covered under the European Union's emissions trading system and carbon taxes. In addition to the aforementioned policies, Colombia is developing the National Greenhouse Gas Emissions Transactional Quotas Program (PNCTE its abbreviation in Spanish), and Chile and Brazil are considering implementing similar projects. Likewise, Brazil's flagship policy, *RenovaBio*, was developed to meet the country's goals, in its NDC, of a 10% reduction in transportation GHG emissions by 2028 and an 18% share of biofuels in the region's energy matrix (IEA, 2020).

The Carbon Price

The price of carbon or pollution is one of the most efficient economic mechanisms to change the behavior and consumption and production patterns of households and firms. Although taxing pollution can have regressive distributional impacts in several countries (IPCC, 2014), the tax collection of these taxes can be distributed in such a way, as to reduce the economic inequality that exists in the countries of the region.

Fossil Fuel Subsidies in the Energy Sector

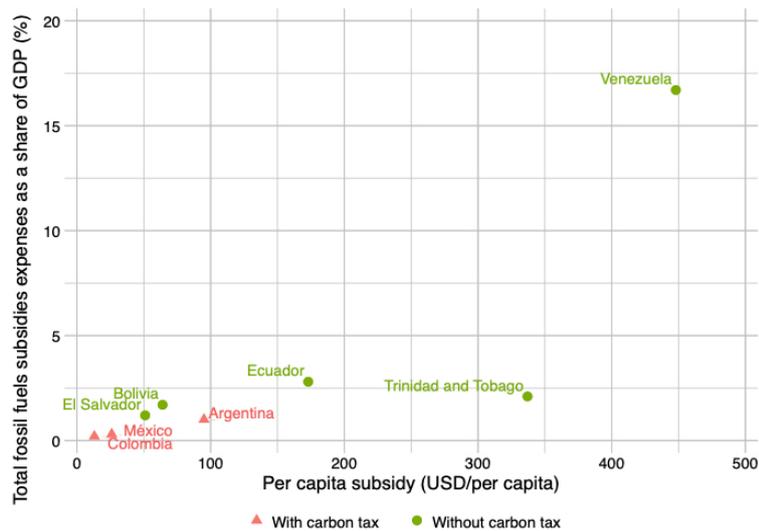
One of the central axes in the Paris Agreement is the reduction of GHG emissions, particularly those produced by the exploitation and consumption of fossil fuels. Likewise, this exploitation and use also have a dangerous impact on the health and well-being of the population since, air quality frequently exceeds the standards of the World Health Organization, to a large extent because of fossil fuels.

For these reasons, there is a global need to reform fossil fuel prices, especially to make them more expensive and less attractive than clean alternatives. One way to do this, is through carbon taxes, which are not only easy to implement in an already implemented tax collection system, but also have a wide reach to the 'taxable' base of polluting goods and services. However, in many countries there are subsidies on these fuels which can blur the disincentive of the carbon tax. The following figure shows the total subsidies per capita on fossil fuels and the percentage of GDP of each country that these subsidies represent.

¹⁷ See more in Secretary of the Government of Mexico (2019).



■ **Figure 25.** Per capita subsidies to fossil fuels vs. Percentage of GDP per capita by country, 2019



Source: IEA (2020).

In the region, the total subsidies per capita is on average USD 151 per person. During 2019, the countries in the figure, in total, spent a little more than USD 25.5 billion in subsidies for all fossil fuels. Led by Venezuela that spends 16.7% of its GDP on these subsidies, the region spent a total of USD 25,520.7 million in fossil fuel subsidies. Within each country the distribution of these is different and following the IEA classification (2020), the following table shows the resources assigned by each country to each classification.

■ **Table 4.** Distribution of fossil fuel subsidies by subsector in the countries of the region during 2019, real prices in millions of dollars

Country	Oil	Electricity	Gasoline	Coal
Argentina	3163.9 (74.24%)	133.6 (3.14%)	962.6 (22.59%)	1.4 (0.03%)
Bolivia	686.3 (93.54%)	-	47.4 (6.46%)	-
Colombia	661.7 (-100%)	-	-	-
Ecuador	3003.3 (-100%)	-	-	-
El Salvador	17.2 (5.2%)	313.2 (94.8%)	-	-
Mexico	21.0 (0.64%)	3262.8 (99.36%)	-	-
Trinidad and Tobago	3163.9 (74.24%)	67.1 (14.28%)	-	-
Venezuela	3163.9 (74.24%)	4533.1 (35.48%)	1136.3 (8.89%)	-

Source: IEA (2020). In parentheses, the percentage of total fossil fuel subsidies by country.

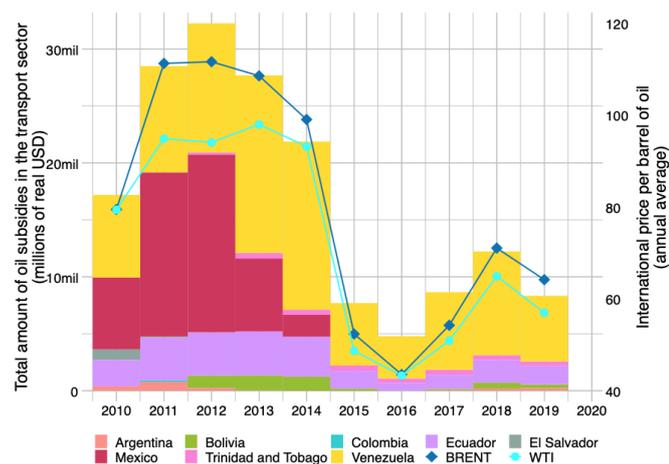
With the exception of Mexico and El Salvador, the largest budget, of the countries of the region, in fossil fuel subsidies is used in oil. In fact, in countries like Colombia and Ecuador it is the only fuel that is subsidized in the energy sector, and for Argentina, Bolivia and Trinidad and Tobago it represents more than 70% of the subsidies. In total, oil received subsidies of more than USD 15 billion in 2019. Two other energy sub-sectors whose fossil fuels also received subsidies are, natural gas and coal, which took a total of just over USD 2 billion. Finally, for the generation of electricity, only Venezuela and Mexico invested almost USD 8 billion to subsidize fossil fuels. It is important to highlight this subsidy since it may be part of the interests of governments to guarantee access to electricity by households and/or



firms. However, instead of subsidizing the use of fossil fuels for the production of this public service, these resources can be used in other sources of primary renewable or nuclear energy, and in this way, encourage the use of these cleaner alternatives.

Within the energy sector, the oil subsidy in the transportation sector plays an important role. In fact, these subsidies represent 55.36% of the oil subsidies in the region. At the beginning of the decade, the countries managed to spend a total of more than USD 30 billion, led mainly by Venezuela and Mexico. Although, today, the amount of subsidies is a little more than half that in 2012, they still have an important fraction for countries like Venezuela and Ecuador. The following figure shows the total amount of oil subsidies in the transport sector from 2010 to 2019 by country and the annual average of international prices per barrel of oil (axis 2).

■ Figure 26. Oil subsidies in the transportation sector by country



Source: IEA (2020) and Statista (2020).

The removal of fossil fuel subsidies can not only lead to reductions in GHG emissions in the region, but can have fiscal and budgetary benefits for each country. In particular, there is the case of Venezuela where more than 15% of its GDP is dedicated to these subsidies. Another benefit of this cut is that it can help the transition to clean energy since fossil fuels will no longer be 'cheap' and the other alternatives will be more attractive. It is important to keep in mind that the total amount subsidized in the transportation sector moves positively with international prices per barrel of oil, which shows a bit of the degree of volatility dependence on these prices, which can be transferred to the countries' fiscal budgets.

Part II. Latin America and the Caribbean in 2030 and beyond: Policies to achieve environmental and climate goals

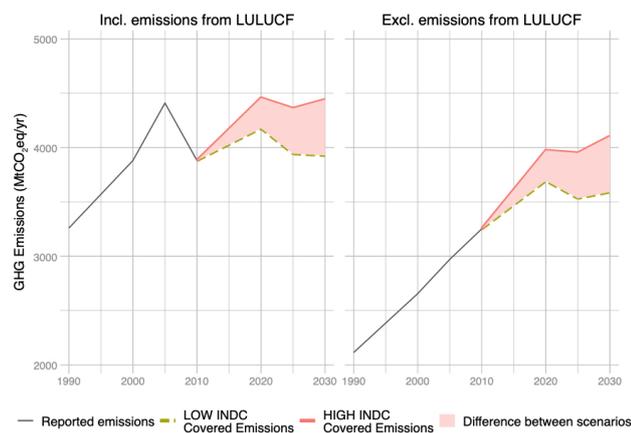
Latin America and the Caribbean are home to great natural wealth, but population and economic growth are putting biodiversity, the quality of life of its inhabitants and even the future of biomes on which the regulation of CO₂ and climate change affecting the planet depends on, at risk. Throughout this document, we touched on some of the main environmental indicators in the region to outline the potential in environmental terms, but at the same time show the tangent threats it faces with climate change.



The countries of the region are part of the most important international agreement for climate change mitigation, the Paris Agreement. For this agreement, each of the countries of the region reported in their NDC goals on the expected emissions and their mitigation and adaptation commitments. Although it continues to be a growing region, the climate commitments of the signatory countries of Latin America and the Caribbean intend that their participation in global emissions does not do so at the same rate. In fact, the region's emissions will grow by 26.2% between 2010 and 2030 according to INDC commitments, but will continue to be just over 7% of global emissions. The following figure shows emissions in two scenarios:

- (i) low, which includes conditional and unconditional environmental commitments, and (ii) high, which includes conditional and unconditional commitments.

■ Figure 27. Emissions projections according to INDC commitments of the countries of the region¹⁸



Source: Climate and Energy College (2016).

As figure 26 shows, in the region there will be growth in GHG emissions by 2030. But this growth will be mainly linked to other sectors, other than land use. However, land use continues to play a significant role in the emissions produced in the region, since they represent at least 12.5% of the emissions from other sectors. To achieve these goals, the region's natural and economic potential must be used by attacking different fronts, including land.

The COVID-19 pandemic has been a natural experiment that has changed, at least temporarily, human behavior and, above all, has highlighted our impact on the planet. León and Cárdenas (2020) point out environmental eruptions that the pandemic has generated in the region, as well as, a series of windows of opportunity that have been opened during this crisis. Although attention to the pandemic has become the priority, climate change will continue to be a threat to the future. The IPCC has repeatedly called for a drastic change in "business as usual" in order to mitigate the climate crisis, and that we are at the right time to do so. Following the recommendations of the IPCC (2014) and the windows of opportunity opened by the pandemic in the region (León and Cárdenas, 2020), below, we outline some of the policy mechanisms that the region can use to change its path and thus, achieve its climatic goals.

Economic instruments that seek to put a price on pollution are important to discourage polluting activities in economies. One of the most commented on is, carbon taxes. Currently, only four countries in the region have this tax, despite the fact that its operation and applicability are relatively easier than other mechanisms. Likewise, the amounts

¹⁸ LULUCFs are emissions produced by Land Use and Changes in Land and Soil Use.



of these taxes are still too low to meet climate goals. Among the recovery policies of the impact of the COVID-19, these taxes should be taken into account, since they can represent a high margin of tax collection, which can be used to reduce the impacts caused by the isolation policies and the drop in daily activities. In this scenario, inconsistency and redundancy of policies should be avoided. For example, countries should not tax pollution and, at the same time, subsidize fossil fuels. Dismantling fossil fuel subsidies would not only alleviate government portfolio, but would result in a significant reduction in GHG emissions (*Burniuax and Chateau, 2011*).

Another mechanism in the region to discuss, may include tradable emissions rights systems. Although their operation and application are not as simple as creating a carbon tax within current tax regimes, several countries have begun to implement these systems in the region since they face less economic and political interest than the carbon tax. Finally, using subsidies to promote clean alternatives can speed up the change in households and firms that is needed. A set of subsidies that includes a scheme of "Feed-in-tariffs" for renewable energies, subsidies for biofuels, "feebates" programs, tax incentives for investments in their use, consumption and modernization of clean technologies, and even lines of credit that stimulate sustainable agricultural practices.

Putting a price on pollution has not been used by many countries, but instead, policies that impose regulatory approaches. However, according to air quality reports, there is still a lack of requirements in the standards used. To begin with, environmental and efficiency standards must be imposed in the energy sector, including renewable energy. Although the latter are cleaner alternatives than fossil fuels, it is important to monitor and ensure that accidents, with the worst environmental consequences, do not occur.

Likewise, in the region there is a need for regulations on the transportation sector, in particular on fuel quality standards. During 2019 and early 2020, Latin American cities had concentrations of articulated material much higher than the standards imposed by the WHO. Although on some occasions this may be due to meteorological phenomena, the vast majority of the year was related to pollution produced in cities or by forest fires. It is necessary to increase transport regulations, both public and private, it can mean relief in the health system, thanks to the impacts generated on the population, such as respiratory diseases. Air quality is also affected by industry and land use sectors. This is why regulations and cross-cutting policies must be proposed, to all sectors of Latin American economies, so as to promote the right to clean air and protect the region's population.

Taking advantage of the concern and attitudes in Latin American cities on environmental issues¹⁹, one policy mechanism that can be implemented is the information programs on the environmental impacts of goods and services. These information programs can allow consumers to be aware of the emissions produced by their demand. A set of policies for fuel labeling, vehicle efficiency, energy sector auditing and even certification schemes for sustainable forest practices.

Particular attention should be paid to the land sector. This sector is not only the largest source of emissions in the region, but it also needs transformation and conservation that protects the communities that live within and subsist in rural areas. By adding credit lines under clean development schemes, taxes can also be used in the land sector that reduce the use of nitrous oxide and other fertilizers that harm the soil and produce GHG, forest laws that reduce deforestation. National policies are also necessary that guarantee monitoring, reporting and verification of effective compliance with REDD+ goals and regulations on planning and governance of land use.

Government provision of goods and services is also crucial to mitigation goals. State investments in investment and development are necessary, especially to improve the installed capacity of renewable energy production, as well

¹⁹ See more in León and Cárdenas (2020).



as investments in the renovation of infrastructure for transportation services and other fuel alternatives. In this set of direct state actions, it is also necessary and important to include, the role of the state to manage laws to protect local and national forest areas.

Achieving a sustainable recovery is one of the greatest challenges that current world governments will face. Although much of the impact caused is irreversible, the call is to make policy decisions that do not produce a rebound when returning to 'normal' the world was at before 2020. Latin America and the Caribbean have a set of social, economic and natural characteristics that gives them a comparative advantage to reverse and change current trends. All these advantages together with the appropriate policies, can generate a path of green growth that allows the countries of the region to recover from the COVID-19 crisis and in turn strengthen their ability to sustain the fundamental role that their natural wealth has to sustain life and the economy.

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Appendix.

1 Source of information on air pollution.

City	Source
Bogotá	El Observatorio Ambiental de Bogotá (OAB)
Buenos Aires	Control y monitoreo de la autoridad de cuenca Matanza Riachuelo (acumar)
Mexico City	Instituto Nacional de Ecología y Cambio Climático (INECC)
Guatemala City	US Embassy Air Quality Monitor, Guatemala City
El Salvador	Ministerio de Medio Ambiente y Recursos Naturales (MARN)
San José	US Embassy Air Quality Monitor, San José
Santiago	Sistema Nacional de Calidad del Aire en Chile
Lima	Sistema de gestión de Calidad del Aire en Perú
São Paulo	Instituto Estadual de Meio Ambiente e Recursos Hídricos
Willemstad	US Embassy Air Quality Monitor, Curacao

2. Standards for the concentration of particles in the air.

Air quality category	PM _{2.5} µg/m ³ averaged over 1 hour	PM ₁₀ µg/m ³ averaged over 1 hour
Good	Less than 27	Less than 40
Moderate	27–62	40–80
Poor	62–97	80–120
Very poor	97–370	120–240
Hazardous	More than 370	More than 240

Source: EPA (2020a) and EPA (2020b).

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