

## Renewable Energy Sources In Latin America For The Period 2009 To 2020

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**Abstract.** The IPCC is the group created to evaluate science related to climate change. It was established in 1988 with 195 members. During this time, it has published five (5) reports, and is currently preparing the Sixth. The 2020 marks the 30th anniversary of the publication of the First Report. In the 4th and 5th reports it is ensured that climate changes are unequivocal and are also the responsibility of human activity with 95% certainty. Among the activities responsible for the changes, the production of electrical energy from fossil fuels stands out. Latin America has distinguished itself with respect to other regions of the world, for having a clean matrix based on renewable sources and for producing less than 5% of global greenhouse gas emissions. This work shows how the development of low emission sources in the region has been for the last 10 years.

**Keywords:** Renewable energy sources, Latin America, Energy Matrix.

### 1. Introduction

The greenhouse effect and climate changes have caused a new way of thinking about the consumption and use of natural resources that we currently carry. The Intergovernmental Panel on Climate Change (IPCC) [1] was established in 1988 in order to provide policy makers with scientific and periodic assessments of climate change, its implications and potential future risks,

additionally proposing adaptation and mitigation measures. This group has prepared and published five (5) reports on climate change, its causes, potential impacts and possible alternatives to mitigate it. In 2020, the 30th anniversary of the publication of the first report is celebrated [2], where there was a presumption about the effects of the climate product of anthropogenic activity. Currently, it is preparing its sixth report, which is expected to be published in 2021.

In the Second Report of 1995 [3], great strides were made to try to distinguish between natural and anthropogenic influences on climate. In 2001, after the publication of the Third Report [4], in all the projected emission scenarios, it was anticipated that the concentrations of carbon dioxide (CO<sub>2</sub>), the average temperature of the planet's surface and the sea level would increase during the 21st century. In addition, a reduction in greenhouse gas (GHG) emissions was necessary to stabilize their atmospheric concentration and be able to delay and reduce the damage caused by climate change [4].

The Fourth Report of 2007 [5], conclusively indicates that the warming of the climate system is unequivocal, since it has been observed that the world average of the temperature of the air and the ocean, the generalized melting of snow and ice and the global average sea level rise [5]. The Fifth Report of 2014 [6] is more conclusive in ensuring that with 95% certainty, human activity is currently the main cause of global warming and climate change. Among these effects of climate change we have the increase in the average temperature of the air and the oceans and, among its impacts, the rise in sea level and the generalized melting of snow and ice have been registered. In turn, these effects cause loss of biodiversity registered since the last century and the impact on ecosystems, demonstrating the vulnerability of living beings to these changes.

Currently, the Sixth IPCC Report is being prepared. So far, three (3) special reports [7] [8] [9], two (2) methodological report [10] [11] have been published, and the Sixth Assessment Report is under development. Finally, by 2022 the first global inventory will be completed under the Paris Agreement [12] and the Sixth Assessment Report is expected to be published.

According to the different IPCC reports [1-5], the concentration of GHG is a product of the consumption of fossil fuels and, globally, this change is due to the energy supply sector, transport, industry and the use of soil and forest resources. Being essential for its mitigation to achieve sustainable development. To reduce emissions in the energy area, policies have been implemented for the energy transition to a global matrix less dependent on fossil fuels and with a higher proportion of the use of renewable, conventional (hydroelectric) and unconventional (solar, wind and others).

As shown in Table 1, Latin America (including the countries of Central America and Mexico) is responsible for less than 5% of CO<sub>2</sub> emissions. However, since climate activity has no borders,

measures and actions have been implemented to further reduce these emissions and comply with the Paris Agreement [12].

Table 1. CO<sub>2</sub> emissions by region for the year 2019 [13]

Region	CO <sub>2</sub> Emissions (millions of tonnes)
North American	5.975,9
S. & Central American	1.254,9
Europe	4.110,8
CIS	2.085,3
Middle East	2.164,1
Africa	1.308,5
Asia Pacific	17.269,5
Total	34.169,0

According to the latest report published by the company bp in 2020 [13], worldwide primary energy consumption grew by 1.3% in 2019, compared to the previous year. However, GHG emissions grew by 0.5%, due to the implementation of renewable energies and policies as well as other alternatives for energy efficiency and efficient consumption. It is maintained that China, the US and India are the countries that produce the highest CO<sub>2</sub> emissions with 9.25,8; 4.964,7 and 2.480,4 million tons for the year 2019, respectively, representing approximately 50.5% worldwide.

Table 2 shows, according to the type of primary energy, which has been its increase in 2019, compared to 2018, where there is a decline in the use of liquid fuels and coal and an increase in the use of natural gas and renewables, including biofuels. Finally, there is a worldwide stagnation of hydroelectric plants. Despite the fact that hydroelectric plants have low GHG emissions, only those of the methane product of their reservoirs [14] [15] [16], the construction costs and their vulnerability that have been demonstrated in the face of drought periods worldwide has made investment in new projects slows down.

Table 2. Fuel shares of primary energy and contributions to growth in 2019 [13].

Energy Source	Consumption	Annual	Annual	Percentage
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	(exajoule)	Change (exajoule)	Share Change of primary (%)	point change in share from 2018 (%)
Oil	193,0	1,6	33,1	-0,2
Gas	141,5	2,8	24,2	0,2
Coal	157,9	-0,9	27,0	-0,5
Renewables*	29,0	3,2	5,0	0,5
Hydro	37,6	0,3	6,4	0,0
Nuclear	34,9	0,8	4,3	0,1
Total	583,9	7,7		

\*Renewable power (excluding hydro) plus biofuels

The energy matrix of Latin America has been distinguished worldwide for having one of the cleanest, in comparison with other regions of the world. Its hydroelectric potential is approximately 3 GW / year, for the last stage of the five-year period 2010-2015, with growth over the previous year of 2.2% [17]. However, the vulnerabilities of these electrical installations to the effects of climate change and backup systems for non-conventional renewable sources, mean that the use of energy sources based on fossil fuels is maintained for some more periods.

Additionally, Latin America is distinguished by the diversity of unconventional sources of energy, such as photovoltaic, wind, use of biofuels and others. In this sense, the present work aims to show the growth and diversity of the use of renewable energy sources in the region.

## 2. Renewable sources of energy

### 2.1 Conventional source: Hydroelectric

Latin America has been distinguished by its important hydroelectric potential, being in the region the binational Itaipu Hydroelectric, between the countries of Brazil and Paraguay. In Fig. 1 the generation in the electrical installations of the region for a period of 10 years is shown, where its variability is shown, since it is vulnerable to the effects of global warming, by intensifying the periods of drought.

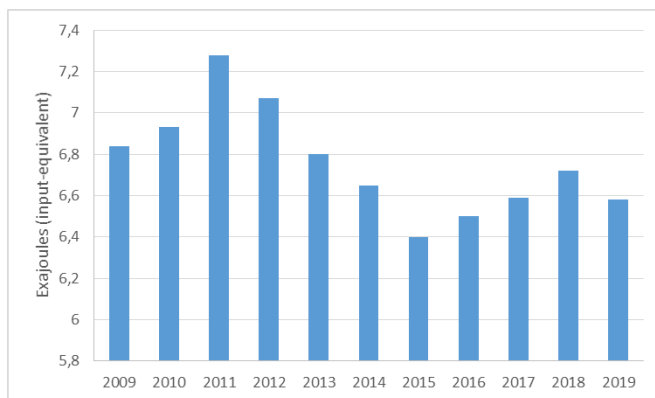


Fig. 1. Hydroelectric generation in Latin America for the period 2009-2019 [13]

## 2.2 Non-conventional Renewable Sources

Among the non-conventional renewable energy sources in Latin America, the use of photovoltaic solar energy, wind energy and the use of biofuels are distinguished. As shown in Fig. 2, its use has grown exponentially.

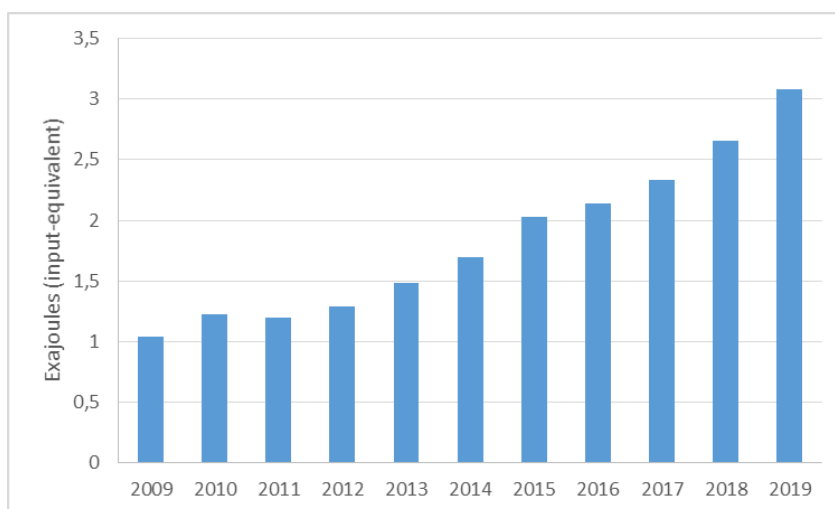


Fig. 2. Renewable generation with unconventional energy sources in Latin America for the period 2009-2019 [13]

### 2.3 Nuclear energy

Fig. 3 shows the share of electricity generation based on nuclear power plants in Latin America, for the last 10-year period. It is evident that its contribution has been approximately 0.3 exajoules, comparatively lower than the contributions with other renewable sources.

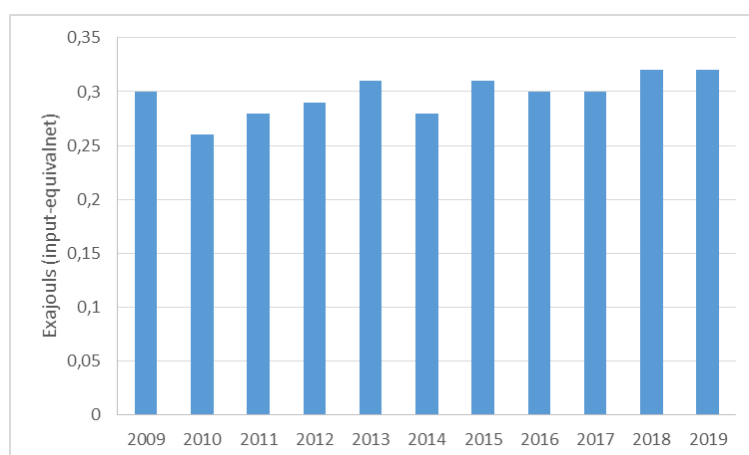


Fig. 3. Nuclear Generation in Latin America for the 2009-2019 period [13]

### Conclusions

The IPCC is the group created to evaluate science related to climate change. It was established in 1988 with 195 members. To date, it has published five (5) reports and is currently in the preparation of the Sixth. This year 2020 marks the 30th anniversary of the publication of the First Report. In the Fourth and Fifth reports, it is ensured with 95% certainty that climate changes are unequivocal and are the responsibility of human activity. Other activities responsible for this change are transportation, industrial activity and deforestation.

Among the activities responsible for the changes, the production of electrical energy from fossil fuels stands out. Latin America has distinguished itself with respect to other regions of the world, for having a clean matrix based on renewable sources and for producing less than 5% of global greenhouse gas emissions. This work shows how has been the development of low emission sources in the region for the last 10 years. There is an exponential growth in generation based on non-conventional renewable generation sources. Additionally, there is a stagnation in generation based on hydroelectric and nuclear power plants.

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