Latin America towards Sustainability through Renewable Energies: A Systematic Review

Renzo Seminario-Córdova

Training and Teaching Research Program, Cesar Vallejo University, North Lima Campus, Lima 15314, Peru; rseminarioc@ucv.edu.pe

Abstract: Nowadays, the increase in global energy demand is notorious, a situation that, in turn, impacts the environment through the generation of pollutants that are harmful to the planet. In this sense, an energy transition towards clean energy sources, also known as renewable sources, is essential, as well as better energy management and a responsible use of available natural resources. In this context, the objective of this systematic review was to analyze the use of renewable energy sources in Latin America, in addition to the guidelines established for their use, and the consequences of the use of non-renewable sources. Therefore, the PRISMA method was applied, and 60 publications were selected, from which the existing interest in this region in combatting the increase in energy demand and the use of fossil fuels through renewable energies is evidenced. Finally, it is concluded that there is still a need for greater dissemination in the region regarding this problem, as well as greater actions on the part of industries and governments to make proper use of this type of energy source.

Keywords: clean energy; climate change; greenhouse gases; pollution

1. Introduction

Technological development has induced important changes in humanity’s way of life, and most of these changes are related to energy use [1]. Since industry and transportation depend on fossil fuels, there is an increase in the demand for energy [2], as well as the generation of CO₂ emissions and other pollutants that increase the global temperature of the planet and the environmental problems by seriously affecting vegetation, crops, the balance of ecosystems and fauna. In this context, all organizations worldwide have made efforts in recent years to protect and safeguard the environment by signing agreements and treaties to regulate the use of pollutants and the amount of harmful emissions and to curb the environmental impact of human activities [3,4]. This is reflected in the creation of accords such as the Paris Agreement by the United Nations, with the objective of mitigating climate change and considerably reducing global temperatures, in addition to accelerating investments and actions for a more sustainable future [5].

In this regard, the importance of a proportionate use of energy resources and the need to decarbonize the economy through an efficient and rational use of energy becomes evident. In addition to this, there is a current focus on renewable energy sources [2]. Currently, nuclear power and fossil fuels provide more than 80% of the energy used in the world annually. From the mid-20th century onwards, the increase in industrial production, population growth and the massive use of technologies began to generate concern about the depletion of oil reserves and environmental deterioration. In this context, water, air and soil pollution threatens the productivity of the system, affecting the sustainability and welfare of future generations [6]. The global need for electricity is increasing. Therefore, it is essential to create new renewable energy systems that can decrease dependence on traditional energy sources [7].

The need to increase the contribution of renewable energies is justified by the decline in current fossil reserves, but mainly by the need for a reduction in greenhouse gas emissions [8]. In this context, according to the 2016 IRENA (International Renewable Energy...
Agency) database, only 14% of the global primary energy matrix currently comes from renewable sources; in the electric power sector, this percentage is currently around 25% and will increase to 85% by 2050. IRENA noted that geothermal, concentrated solar and oceanic renewables will experience considerable expansion. The latter will generate 4% of total electricity, but solar and wind power plants will account for the largest share of renewable electricity sources by 2050 [9].

Providing people with access to electricity has a positive impact which is evident in many aspects of life, such as health, income and education, among others. In this sense, electricity increases the number of hours of study, providing students with better school performance, thus favoring their future insertion in the labor market. On the other hand, the lack of electricity affects the population’s capacity to produce wealth or basic health care [1].

Currently, electricity costs are the highest in households compared to the costs of other types of services. Therefore, to reduce these costs, the use of non-conventional renewable energy sources, which are alternative forms of energy generation that take advantage of renewable energy sources such as wind, solar, hydro, geothermal, tidal and biomass sources, has emerged. In addition, it is possible to reduce polluting emissions into the environment [10]. Electricity obtained from renewable energy sources such as solar and wind sources has had rapid growth in recent years. In this sense, wind and sun are considered unlimited, unlike fossil fuels such as oil and coal that have a limited duration [11].

In this regard, in order to limit the increase in the global average temperature to 1.5 °C and thus mitigate the effects of the current climate crisis, it is imperative that the world reaches carbon neutrality in the first half of this century [12]. To this end, the search for biofuels as alternative energies based on renewable and less polluting natural resources has been stimulated. One way to achieve a development path with the perspective of protecting the environment is through the processing of organic waste (biomass) in biodigesters for energy purposes. In this context, biomass can come from animal or vegetable waste and be transformed into bioenergy [13].

In recent years, numerous nations around the world have been promoting initiatives to include energy generation from non-conventional renewable resources instead of conventional thermal energy with the aim of, among other things, reducing the negative effects of climate change and achieving more sustainable development for all the benefits they bring. In this context, renewable energies worldwide reached a significant level of development by 2020, with an installed capacity of 2,799,094 MW. Figure 1 shows the main renewable energy sources worldwide [14].

![Figure 1. Global installed capacity of renewable energies in 2022 [15].](image-url)
Figure 1 shows that Asia and Europe are the regions with the largest installed capacity, with the former showing a large difference with respect to the rest of the world. Similarly, cases such as Latin America stand out, which, despite having a large reserve of fossil fuels, great potential, solar, hydro, wind and good weather conditions, among other things, present a complicated energy transition to these new energy sources. This is mainly due to factors such as their high dependence on economic benefits obtained from activities such as the production and export of fossil fuels [16]. Additionally, Figure 2 shows the installed capacity to harness renewable energy in Latin America for each country in the region.

Figure 2. Renewable energy sources for each country in Latin America in 2022 [15].

Figure 2 shows that, among Latin American countries, Brazil stands out in the use of renewable energies because it is one of the largest suppliers of clean energy in the world. However, there are factors that put the nation’s future sustainable energy performance at risk, such as the increase in energy demand, with the main use of fossil fuels, rapid increase in greenhouse gas emissions, energy efficiency with deterioration in its performance, struggle for the expansion of the bioenergy sector and increase in oil production [9].

In this context, and along with the existing worldwide interest in using environmentally friendly energy sources, the objective of this paper is to analyze the process of implementation of renewable energies in Latin America. More specifically, it seeks to explore the energy potential of this region regarding these new energy sources and to address questions regarding the current situation of the progress in the energy transition in Latin America towards clean energy sources, as well as the policies implemented by the different countries with the purpose of encouraging their use in the future.

2. What Is Renewable Energy?

According to the International Energy Agency (IEA), renewable energy is defined as energy obtained from natural processes that can be constantly replenished [17]. One way to generate electricity is photovoltaic panels, elements with the ability to convert solar energy into electricity. These devices are becoming increasingly popular because of their
efficiency, low cost and avoidance of long wiring. Even in most rural areas, photovoltaic panels would be a fairly reliable way to supply power to residents. With the advancement of technology, the efficiency of these renewable energy sources is increasing, and their use is on the rise [18].

Geothermal energy is heat energy that is stored inside the Earth and brought to the surface where it can be used [19]. This energy is reliable because it is independent of weather conditions. The areas closest to volcanoes are usually the best for using this resource. It is classified as a renewable natural resource due to the continuous natural restoration of heat from an active reservoir by natural recharge and reinjection of the extracted geothermal fluids after their consumption [20]. This heat is generated by physical processes occurring at the surface and comes from the interior structure of the planet. On the Earth’s surface, phenomena such as fumaroles, geysers and hot springs can be observed, demonstrating that heat can escape from the subsurface [19].

It is also self-sufficient, sustainable, renewable and capable of generating baseload power with a minimum 50-year lifetime and low operational cost. It is a flexible energy source that works well with other “intermittent” renewables such as sun and wind. While the operational capacity of the latter two sources depends on meteorological factors (such as wind or sun levels), geothermal power plants will provide electricity consistently throughout the day [20]. Geothermal energy can be used for a variety of purposes, such as building and water heating, balneology, greenhouse and soil sterilization, textile drying and electricity generation, among others [19].

In environmental terms, it should be noted that this type of energy generates low or zero CO\textsubscript{2} and noise emissions. It requires very little land area compared to other renewable energies. Although geothermal energy has several benefits compared to other sources of electricity generation, it faces difficulties that must be addressed in order to become an attractive resource for investment in its development. The barriers to overcome are related, on the one hand, to the relatively scarce locations of these resources and, on the other hand, to the high risk and capital-intensive expenditure in the exploration phase [20].

Likewise, wind energy is a renewable energy source that generates electricity through the kinetic energy of the wind. Currently, it supplies 5% of the world’s energy and represents 32% of the total renewable energy generation [4]. On the other hand, dams have been used in different parts of the world for centuries to store river water and subsequently use it for various purposes, such as water supply for the population and crop irrigation. With the development of electric energy towards the end of the 19th century, dams have the function of generating electricity, thus generating hydroelectric energy [21]. According to the International Energy Agency (IEA), this type of energy will be a key source of electricity generation in the future [22].

Another type of renewable energy is ocean energy, also called marine renewable energy. Through technologies associated with ocean energy, it is converted into electricity, harnessing the potential properties of ocean water, as well as its chemical and heat potential, as a driving force. Additionally, tidal amplitude, ocean current, salinity, ocean surface waves, tidal current and thermal gradient are used. However, it is important to highlight that, in order to obtain a competitive cost regarding the production of other energy sources, large-scale installations, innovation and learning curves are needed [9]. Offshore wind energy in the 1990s, due to its high costs and incipient technological development, was initiated in some developed countries such as Sweden, Denmark, Norway, the Netherlands and Germany. Gradually the problems of high cost and technical limitations were solved, positioning it today as one of the energy sources of the future. Therefore, today, there are already offshore wind farms in different countries in Asia, North America, Europe and Oceania [23].

On the other hand, hydrogen, the lightest chemical element in the periodic table, has a high calorific value, much higher than methane, gasoline, diesel and methanol, as a potential fuel, since its combustion releases a large amount of energy and water as a product. Given the need to store electrical energy, one option instead of expensive and inefficient
battery storage is to store energy in the form of hydrogen, using excess renewable energy for its production. Today, with scientific advances, it is possible to extract hydrogen from different sources, for example, water, petroleum (and derivatives), natural gas, ethanol, methanol, biomass, biogas, algae, glycerol, etc. [5].

3. Materials and Methods

3.1. Research Approach

Through the use of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, a systematic review of the literature was carried out to integrate the results of studies on a specific topic [24]. The study focused on gathering information on renewable energies and how they are being used in Latin America. In addition, the bibliographic manager Mendeley was used to organize, store and analyze the bibliographic references obtained in the search [25].

3.2. Search Strategies

The information used in this review was obtained using two bibliographic databases: ScienceDirect and SciELO (Scientific Electronic Library Online), which include a large number of scientific articles, both in Spanish and English, from different parts of the world, including Latin America and the Caribbean [26]. Additionally, the following keywords were used for the search: in English, “renewable energy”; in Spanish, “energía renovable”, “energías limpias” or “energías alternativas”; and in Portuguese, “energias renováveis”. The keywords were combined using Boolean operators such as “AND” applied to terms such as “renewable energy” and “Latin America”, among others.

3.3. Inclusion and Exclusion Criteria

Considering the objectives established for this systematic review, the articles selected met a series of inclusion and exclusion criteria focused on obtaining updated and relevant publications according to the topic addressed. These criteria are listed in Table 1.

Table 1. Inclusion and exclusion criteria.

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Publications in Spanish, English and Portuguese.</td>
<td>Publications in other languages.</td>
</tr>
<tr>
<td>Publications from ScienceDirect and Scielo databases.</td>
<td>Publications in other databases.</td>
</tr>
<tr>
<td>Publications referring to renewable energies and their use in Latin America.</td>
<td>Publications related to other subjects.</td>
</tr>
<tr>
<td>Review and research publications.</td>
<td>Publications of other types (reviews, monographs, theses, etc.).</td>
</tr>
</tbody>
</table>

Source: Own elaboration.

3.4. Selection Process

After an initial search for articles with keywords related to the topic of study, a total of 465 articles were obtained. From this first group selected with the help of the Mendeley bibliographic manager, the articles were stored, and duplicate publications were eliminated. The final selection was made taking into consideration the inclusion and exclusion criteria indicated in Table 1.

Based on these defined criteria, the goal was to ensure that the articles subsequently selected were adequately aligned with the established subject matter, in this case, the implementation of renewable energies in Latin America. In this way, highly relevant and updated information was obtained, useful for the understanding of the aspects of interest regarding the situation of this type of energy source in this region. In addition, it was decided to select only articles with a DOI (Digital Object Identifier) as well as limit the search to the chosen databases. This was decided in order to correctly identify the
articles that were part of this study, as well as to strengthen the reliability of the findings presented. Additionally, the information obtained was complemented by statistical data from governmental sources such as IRENA.

For the second group of 239 articles selected, a more complete analysis was carried out, reviewing the full text of each one, finally selecting the 60 articles that are part of this study. The selection process of the articles at each stage can be seen in Figure 3, achieved as a result of applying the PRISMA methodology.

![Figure 3. PRISMA method diagram for the selection of articles. Source: Own elaboration.](image)

4. Results

Based on the inclusion and exclusion criteria shown in Table 1, 60 articles were selected for this systematic review. The most important points of each article were recorded in an Excel database to facilitate the analysis of the information [24]. From this, the distribution of articles for each database considered was assessed and is shown in Figure 4.

Figure 4 shows that of the articles selected, 35 (58.3%) correspond to the ScienceDirect database and the remaining 25 (41.7%) to the SciELO database, from which a slight predominance of articles from ScienceDirect can be observed. In addition, Figure 4 shows the distribution of articles by language. There are 38 (63.3%) articles in English, 21 (35.0%) articles in Spanish and 1 (1.7%) article in Portuguese.

From Figure 5, it can be seen that most of the articles are in English. This could be since most of the articles initially selected belong to the ScienceDirect database, which has publications mostly in this language. It is important to highlight that only one article selected is in Portuguese, despite the presence of Portuguese-speaking countries such as Brazil in the region analyzed, probably because high-impact publications are published in English, regardless of the country of origin. On the other hand, Figure 6 shows the number of articles selected according to their year of publication.
From Figure 6, it can be observed that the year 2019 presents the highest number of selected articles, with 16 (26.7%), followed by 2020 with 14 (23.3%) publications. It is observed that in the period 2019–2022, there was a relatively constant number of articles...
published on renewable energies in Latin America. In addition, the small number of articles selected from the current year, 2023, is highlighted, with two (3.3%) publications, considering that this is still a year in progress. Figure 7 below shows the distribution of the selected articles according to the country where they were published.

Figure 7. Distribution of publications by country. Source: Own elaboration.

Figure 7 shows that the selected articles were collected from different parts of Latin America. Among the different countries, Brazil stands out, with 12 (20.0%) publications, the highest number registered among the selected countries, followed by Colombia with 10 (16.7%) publications, and Ecuador, Argentina and Chile, with 7 (11.7%) publications each. For the selection of articles, priority was given to countries with significant contributions in the field of renewable energies, and only publications within the chosen time range were considered. Additionally, this selection was supported by indicators such as the Energy Transition Index (ETI) of 2021 regarding the current situation of Latin America in this field, a measurement that shows the predisposition and the work carried out and projected by the government and energy companies of each country. Table 2 shows the global rankings and the ETI obtained by each Latin American country for 2023.

Table 2. Energy Transition Index (ETI) for Latin America.

<table>
<thead>
<tr>
<th>Global Ranking</th>
<th>Country</th>
<th>ETI</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>Brazil</td>
<td>65.9</td>
</tr>
<tr>
<td>23</td>
<td>Uruguay</td>
<td>63.6</td>
</tr>
<tr>
<td>25</td>
<td>Costa Rica</td>
<td>63.5</td>
</tr>
<tr>
<td>30</td>
<td>Chile</td>
<td>62.5</td>
</tr>
<tr>
<td>34</td>
<td>Paraguay</td>
<td>61.9</td>
</tr>
<tr>
<td>39</td>
<td>Colombia</td>
<td>60.5</td>
</tr>
<tr>
<td>47</td>
<td>El Salvador</td>
<td>57.3</td>
</tr>
<tr>
<td>51</td>
<td>Panama</td>
<td>56.4</td>
</tr>
<tr>
<td>53</td>
<td>Peru</td>
<td>56.4</td>
</tr>
<tr>
<td>68</td>
<td>Mexico</td>
<td>54.1</td>
</tr>
<tr>
<td>74</td>
<td>Bolivia</td>
<td>53.5</td>
</tr>
<tr>
<td>78</td>
<td>Ecuador</td>
<td>52.8</td>
</tr>
<tr>
<td>85</td>
<td>Argentina</td>
<td>52.0</td>
</tr>
<tr>
<td>87</td>
<td>Guatemala</td>
<td>51.9</td>
</tr>
<tr>
<td>93</td>
<td>Dominican Republic</td>
<td>50.3</td>
</tr>
<tr>
<td>100</td>
<td>Honduras</td>
<td>48.0</td>
</tr>
<tr>
<td>103</td>
<td>Venezuela</td>
<td>47.7</td>
</tr>
<tr>
<td>114</td>
<td>Nicaragua</td>
<td>44.9</td>
</tr>
</tbody>
</table>

Source: [27].
In addition, the VOSviewer program was used to examine the text of the publications based on the keywords, in English and in Spanish and Portuguese. To relate the different terms, a minimum value of three occurrences was established. Based on the results, the words less related to the idea of renewable energies, the main theme of this work, were eliminated. With these data, the corresponding bibliometric network was created, which is shown in Figure 8, using the 20 terms selected for this case. The keyword “renewable energies” stands out as the most used in the 60 papers chosen, appearing in 16 of them (26.6%).

![Bibliometric network with keywords of highest occurrence. Source: Own elaboration.](image)

From Figure 8, it can be seen that the terms have been grouped into four well-differentiated clusters by color, green, blue, red, and yellow, with five, four, seven and four terms, respectively.

The green cluster contains the term with the highest occurrence “renewable energies”, present in 16 (26.6%) articles, and, additionally, this cluster groups terms such as “solar photovoltaics”, “solar heating” and “solar power generation”. This is followed by “renewable energy” as the second most frequent keyword, which is within the blue cluster and appears in 14 (23.3%) articles, together with other terms such as “climate change”, “renewable energy” and “biogas”. As for the red cluster, the term “solar energy” has the highest occurrence within it and is the third highest overall, appearing in 11 (18.3%) articles, along with other terms such as “renewable energy”, “solar energy” and “energy transition”. Finally, the yellow cluster groups terms such as “renewable energy source” and “wind power”, present in six (10.0%) and five (8.3%) articles, respectively.

In addition, it was noted that there are words within the clusters that correspond to the same concept, or that are found in both Spanish and English. In this context, “renewable energies”, “renewable energy”, “energía renovable” and “energías renovables” refer to the same concept, the main topic of this article. Overall, this term is present in 40 (66.7%) articles. As this is a high percentage, it is possible to confirm that the selection of articles is adequate. A similar situation occurs with the terms “solar energy”, “solar heating” and “solar power generation”, which, likewise, refer to the same concept and which together are present in 23 (38.3%) articles. Additionally, it is observed that there is a good interrelation between most of the terms, which is reflected in the connecting lines, confirming the correct selection of the articles.

According to the most updated information provided by the IEA, energy production in Latin America in 2020 was distributed as follows: 51% from oil, 18% from natural gas, 15% from biogas, 7% from coal, 7% from hydroelectric power, 1% from solar–wind power and 1% from nuclear power. Documents such as the Renewables Global Status Report complement this information by highlighting the adoption of hydropower as a primary source of electricity generation in this region from an early time thanks to the great existing
potential, with a recent trend towards the implementation of non-conventional energy sources such as solar or wind sources. Some of the studies compiled in this paper show the current interest shown by several Latin American countries in renewable energies, reflected in the technological development and implementation of infrastructure for the use of solar and wind energy in their regions. In this context, the energy transition process arises to replace the use of fossil fuels by the use of renewable energy sources in order to reduce carbon emissions that negatively affect the environment [2,28–32].

Based on this objective, wind farms and solar plants have been implemented in Peru [11], Brazil [33] and Argentina [34], resulting in an approximate 25% reduction in the cost of energy [35]. In addition, there are hybrid plants in Brazil which combine wind and solar energy [36]. Regarding the presence of hydroelectric power plants in the region, they show a high rate of return and a short payback period, reasons that have supported their widespread use in Latin America. However, some of the studies collected evidence of the impact of climate change effects on hydropower [37,38]. In this context, the use of solar and wind energy in Latin America is intended to complement hydropower, and the aim is to develop these energy alternatives so that they can contribute to meeting the country’s energy demand [22].

Although the two previously mentioned sources are the most explored non-conventional renewable sources in Latin America, there are other renewable alternatives for generating electricity, such as residual biomass. This does not produce emissions that affect the environment and can be obtained from food, livestock, forestry and agro-industrial waste [6,13,39–42]. Other available alternatives are geothermal energy [19,20] and green hydrogen. The latter one stands out as an alternative fuel given that its combustion does not generate pollutants and can be used to power vehicles with electric motors [43,44]. On the other hand, some countries have the potential to implement infrastructure to take advantage of offshore wind energy, especially countries with large stretches of coastline, such as Colombia [45], Chile [23] and Brazil [9].

In addition to the existing interest in avoiding environmental pollution through the use of renewable sources, it is important to mention the decarbonization process initiated by some countries with the aim of reducing the use of coal for energy generation [12]. At the same time, the need to include this topic in educational plans at all levels to encourage the population to become interested in this field and seek information about it is also highlighted [46,47]. The government, in turn, is responsible for promoting these alternative sources through actions such as the implementation of regulations and the establishment of decrees and energy plans, among other things, that promote and regulate their use [48–51].

4.1. Renewable Energy Applications in Latin America

According to statistics reported by IRENA, by the year 2022, Latin America had acquired the capacity to generate a total of 312.22 GW from renewable sources, an amount that denotes an important advance in the region if compared to the 185.05 GW that was produced with this type of energy source in 2013. Within this figure, the 200.99 GW produced by hydroelectric power plants stands out, a higher figure compared to the 42.45 GW produced by onshore wind energy and the 44.51 GW produced by solar photovoltaic energy. However, compared to the values produced from these sources in 2013 (5.54 GW for onshore wind, 0.32 GW for solar PV and 162.41 GW for hydroelectric), it is observed that both solar PV and onshore wind had much higher growth in this period than hydroelectric power.

In this context, most of the studies collected focus on the application of some of the renewable energy sources available in the region. However, within this group, the predominance of articles related to solar photovoltaic (11 publications) and wind energy (10 publications) stands out, which reinforces the idea that Latin American countries have great interest in promoting the use of these technologies. Therefore, these studies present some recent applications of these two types of non-conventional renewable energies, the most used of this group for electricity generation in Latin America.
Based on this, Table 3 explores recent applications of solar photovoltaic energy in some Latin American countries, as well as the potential for its implementation in various regions of this territory, according to the selected publications. Similarly, Table 4 explores these same factors for onshore wind energy. Additionally, Table 5 explores initiatives and applications that have sought to integrate these two energy sources to achieve better performance.

**Table 3. Use of solar photovoltaic energy in Latin America.**

<table>
<thead>
<tr>
<th>Country</th>
<th>Use</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colombia</td>
<td>Use of solar panels in the San Agustín building, located in the municipality of Ocaña. This generates savings and reduces dependence on oil by using a renewable energy source.</td>
<td>[10]</td>
</tr>
<tr>
<td></td>
<td>Solar energy has been considered as an alternative for energy availability problems in the department of Cesar. As a result, the construction of the first aqueduct in Colombia with solar and hydraulic energy has been promoted to guarantee the continuity of drinking water service and reduce CO₂ emissions.</td>
<td>[52]</td>
</tr>
<tr>
<td>Chile</td>
<td>Solar photovoltaic energy has great potential in the country, given the high levels of radiation, especially in the northern region of Chile. This country has set aggressive targets for the expansion of non-conventional renewable energies, in addition to seeking to reduce costs and achieve rapid growth in the sector.</td>
<td>[53]</td>
</tr>
<tr>
<td>Peru</td>
<td>The Renewable Energy Center of the National Engineering University of Peru and the Solar Energy Research and Development Group of the University of Jaén, Spain, have implemented two grid-connected photovoltaic systems at the National Engineering University, one with crystalline photovoltaic modules and the other with second-generation thin-film photovoltaic modules.</td>
<td>[54]</td>
</tr>
<tr>
<td></td>
<td>Studies have been carried out to take advantage of the large amount of solar radiation received by the Peruvian territory. An example is the study of an electric load in Lambayeque used to power the five types of residential buildings (single-family bungalow, traditional patio, flat/apartment house, apartments and duplex), estimating the amount of solar radiation using the HOMER program (Hybrid Optimization Model for Electric Renewables).</td>
<td>[7]</td>
</tr>
<tr>
<td>Argentina</td>
<td>In Argentina, the use of renewable energies is still incipient and underdeveloped, which is evidenced by the approval of laws such as Law 24.424/17 to promote their use. Although this law did not have much impact in the country, the public has been increasingly interested in migrating towards this type of energy, especially in urban environments.</td>
<td>[8]</td>
</tr>
<tr>
<td>Brazil</td>
<td>Solar photovoltaic energy is a renewable energy source that is growing in the Brazilian energy scenario, mainly after the approval of Regulatory Resolution (REN) No. 482/2012 of the Brazilian Regulatory Agency.</td>
<td>[55]</td>
</tr>
<tr>
<td></td>
<td>Currently, in southern Brazil, the installed capacity for photovoltaic power generation is much lower than the existing potential in the region, mainly due to barriers such as high initial investment cost, poor quality of the systems, lack of knowledge about this technology, inefficient after-sales services, dependence on China for imports and lack of policies to encourage photovoltaic generation, among others.</td>
<td>[56]</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>Three milk processing plants in the northern Huetar region of Costa Rica use solar thermal and photovoltaic technology. As a result, energy consumption has been reduced and greenhouse gas emissions have been significantly reduced due to the use of solar energy, a completely renewable and clean source.</td>
<td>[57]</td>
</tr>
<tr>
<td>Ecuador</td>
<td>To develop a solar electric production model that meets the demand, it is necessary to analyze a matrix of factors in order to find the optimal algorithm to calculate the daily solar radiation incidence. Studies have been conducted to predict solar radiation in a rural area of Ecuador using artificial intelligence and data analysis to evaluate solar photovoltaic generation capacity.</td>
<td>[58]</td>
</tr>
<tr>
<td></td>
<td>In Ecuador, electricity is considered the main source for producing domestic hot water through water heaters or electric showers. In this context, this country has a high availability of solar resources that can be exploited by making use of more environmentally friendly technologies.</td>
<td>[59]</td>
</tr>
</tbody>
</table>

Source: Own elaboration.
Table 4. Use of onshore wind energy in Latin America.

<table>
<thead>
<tr>
<th>Country</th>
<th>Use</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecuador</td>
<td>The Ecuadorian government has implemented the “Zero fossil fuels in the Galapagos Islands” initiative to reduce diesel consumption and replace it with renewable energies in order to protect this territory considered a UNESCO World Natural Heritage Site.</td>
<td>[60]</td>
</tr>
<tr>
<td>Brazil</td>
<td>Brazil has tried to promote the development of small wind farms and reduce their technological costs through public policies in contrast to the large wind farms that have been used since they began to take advantage of this type of renewable energy. Short-term modeling and simulation structures have been proposed for wind farms in the southern region of Brazil, since reliable operation of these systems requires adequate planning to take advantage of this intermittent energy source. Brazil has introduced several wind farms throughout its territory, including in places such as the municipality of Areia Branca in Rio Grande do Norte (RN). However, this wind farm appears to have had a negligible impact on the local economy, in addition to generating socio-environmental conflicts and distrust among the local population.</td>
<td>[1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[61]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[62]</td>
</tr>
<tr>
<td>Colombia</td>
<td>After signing the Paris Agreement, Colombia generated a large number of opportunities, supported by state policies and economic investment, especially in the construction of wind farms that provide a true alternative to the country’s energy demand.</td>
<td>[4]</td>
</tr>
<tr>
<td>Perú</td>
<td>Qualitative and quantitative evaluations of the wind resource have been carried out in regions such as the city of Juliaca in Puno to characterize its exploitable potential. It was concluded that it is possible to implement small wind generators to take advantage of the low abundance and variable direction of the wind resource. Studies have analyzed the assessment of the availability of renewable energy in places such as Laraqueri, a site located in southern Peru. It was concluded that this location has the appropriate characteristics for the generation of low-power wind energy.</td>
<td>[63]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[64]</td>
</tr>
<tr>
<td>Mexico</td>
<td>The wind farms installed in Tehuantepec, Mexico, have generated dissatisfaction among the population, given the impact of noise and shade on their livestock activities. In addition, the people consider that these installations only benefit those who rent their land and businesses, without including the local communities in the decision-making process regarding wind energy.</td>
<td>[65]</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>Wind energy is an important source of energy in Costa Rica, whose installed capacity reached 597 GW at the end of 2018. There are currently 18 wind farms and 343 turbines, capable of generating between 410 kW and 3 MW of power, which represents more than 10% of the national electricity matrix.</td>
<td>[66]</td>
</tr>
</tbody>
</table>

Source: Own elaboration.

Brazil stands out as one of the countries with the greatest development in terms of renewable technologies, and the Renewables Global Status Report positions it as the leading country in the region in terms of the implementation of solar photovoltaic energy, having added 10 GW by 2021, together with almost 4.1 GW of wind energy, figures that are much higher than those of other countries. In recent years, this country has shown considerable energy growth compared to its neighboring countries. In addition, the country’s hydroelectric capacity stands out, capable of generating more than 120 GW for a maximum electricity demand of 90 GW. This requires maintaining high levels in existing hydroelectric reservoirs to meet the country’s energy demand and complementing it with available wind and solar capacity [22].

Additionally, it is important to mention other methods that have been implemented in the region to curb climate change, such as the use of vehicles with battery electric engines that do not generate CO₂ or other gases responsible for environmental pollution in the region [44]. Figures estimated by the National Association of Sustainable Mobility in Colombia show that, in Latin America, there were a total of 110,206 hybrid and electric vehicles by 2022, with Mexico, Brazil and Colombia being the main countries seeking to increase the presence of electric vehicles in their territory. The use of this type of vehicle has the advantage of being able to be recharged by means of energy obtained from renewable sources.
Table 5. Use of onshore wind and solar energy in Latin America.

<table>
<thead>
<tr>
<th>Country</th>
<th>Use</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peru</td>
<td>Improved technologies have reduced solar and wind energy costs by 82% for photovoltaic solar energy and 39% for onshore wind energy. In this context, countries such as Peru have been able to incorporate this type of energy in the form of wind farms and solar plants located in different parts of its territory.</td>
<td>[11]</td>
</tr>
<tr>
<td>Chile</td>
<td>Studies in this country reveal that an energy system based 100% on renewable energies in Chile would be feasible and even more profitable than the current system. The use of solar and wind energy sources would reduce costs by approximately 25%, aiming to emit zero greenhouse gases by 2050.</td>
<td>[35]</td>
</tr>
<tr>
<td>Brazil</td>
<td>Brazil has sought to generate wind and photovoltaic energy simultaneously to complement these sources and reduce the deficiencies generated by the intermittency of natural resources. The implementation of a hybrid wind, solar and storage plant based on 40% wind energy and 60% solar energy that takes advantage of the high availability of both resources is noteworthy. The region with the largest installed capacity of renewable energy is the northeast region of Brazil. Through the use of incentive policies, the region became a pioneer in the installation of solar and wind power plants. There are 472 parks installed.</td>
<td>[36] [33]</td>
</tr>
<tr>
<td>Argentina</td>
<td>In view of the recent promotion of renewable energies in the Argentine matrix, the province of San Juan is carrying out the energy transition through the development of photovoltaic parks, experimentation in smart grids and the manufacture of solar panels.</td>
<td>[34]</td>
</tr>
</tbody>
</table>

Source: Own elaboration.

Furthermore, there is a growing use of non-conventional energy sources free of harmful emissions, such as green hydrogen, used by nations to accelerate the transition of their energy matrices. ECLAC rankings position Brazil, Colombia and Chile as the main countries in the region in terms of green hydrogen production. In this field, Chile stands out for its superior levels of hydrogen production, which is currently used in industries such as the creation of green ammonia (NH₃), rail transport and biofuels for automobiles, and even the export of this element abroad. With an estimated cost of 1.5 USD/kg of H₂, Chile is among the nations with the lowest hydrogen production costs, which makes it one of the cheapest producers of green hydrogen worldwide [43].

4.2. Energy Transition in Latin America

In recent times, great importance has been given to the so-called transformation of the energy matrix, a concept that refers to the substitution of fossil fuel consumption on a global scale. In this context, the energy transition based on the adoption of renewable energies in Latin American countries has been defined by traditional renewable sources, such as hydroelectricity, as well as non-conventional ones, such as solar and wind sources, among others [29]. Promoting the energy transition to renewable sources and achieving ecological and sustainable development are objectives of both this region and the rest of the world, which is facing problems such as resource scarcity, environmental degradation and climate change. This must be complemented by boosting energy efficiency and reducing consumption, as well as increasing energy security and delaying capital investments. Consequently, the advantages of carrying out energy efficiency activities go beyond reducing carbon emissions, as they also translate into lower operating costs [2,30].

Both the latent danger posed by climate change and its effects, as well as the increase in energy demand in Latin America generated by various productive, extractive, service and residential activities, among others, represent important problems that the region has to deal with. This has led to studies aimed at promoting new forms of energy generation, use and management in both rural and urban regions of Latin America [32]. Therefore, the developing countries that make up this territory not only have the task of supplying themselves with energy from clean sources, but must also continue with the obligation of guaranteeing universal access to electricity for all their inhabitants. Within this challenge,
special emphasis should be placed on rural areas, which generally have limited access to electricity distribution networks [1].

On the other hand, it is important to mention the existence of a series of obstacles and problems that hinder the implementation of infrastructure that takes advantage of the renewable energy sources available in this region. Several renewable sources are operationally limited by fluctuating climatic conditions [20], such as rainfall, wind speed and the strength and frequency of storms. Climate change itself has negatively impacted the performance of hydropower plants in several river basins in South America [37]. An efficient electricity system must be able to guarantee a reliable supply of energy, which is not possible when generation is based on inconsistent sources [20].

In spite of these existing limitations, the different governments of Latin America have dedicated many years to eliminating these problems for the benefit of the energy development of their countries. Countries such as Chile, one of the first nations without government subsidies for clean energy generation, stand out, in addition to having a market in which conventional energy sources and renewable initiatives compete directly [31]. Additionally, they are prioritizing the decarbonization of their electricity system despite the fact that coal represents a significant share of the energy produced for their electricity grid. This poses new challenges for countries seeking decarbonization, as this process requires significant changes in the operational characteristics and flexibility requirements of their systems [12].

On the other hand, there are countries such as Mexico, which has historically relied heavily on the use of fossil fuels to meet its energy demand, reflected in the fact that more than 90% of primary energy consumption in this territory comes from this source, despite it being a country with abundant renewable resources. Despite this and in the midst of a changing political context, it has joined the regional effort to evaluate the resilience of solar photovoltaic energy and geothermal development in its territory. In this context, Mexico has sought to promote the use of these clean sources through incentives such as clean energy certificates, long-term energy auctions and the enactment of laws such as the energy transition law, which defines a series of objectives for the near future [49].

4.3. Policies to Encourage the Use of Renewable Energies in Latin America

For the use of renewable energy sources in the different Latin American countries, it is essential that governments establish the necessary regulations to govern their use. Countries such as Colombia have already made considerable progress in this area, such as with the establishment of decrees that support the development of projects with non-conventional renewable energy sources in the country, as well as the regulation of the procedures required to qualify for tax incentives under Colombian law [51]. These types of energy policies are fundamental in the fight against global warming for the promotion of clean energy. In this sense, countries such as Argentina have focused their energy policies on improving two factors related to efficiency: energy generation and promotion of renewable sources; and energy consumption [50].

In countries such as Uruguay, the incorporation of renewable energies has already become a state policy as a result of an energy plan created in 2008, which was agreed upon by the main political parties two years later. Since then, the use of alternative energies has experienced an important boost within this country thanks to the support shown by the government. These new policies were shown to have a positive impact on the country’s energy transition as, by 2017, all of its electrical energy (of which only 2% came from thermal sources) was produced from renewable resources. Of Uruguay’s total energy, 28.2% went towards the country’s electricity matrix, which was composed of hydroelectric (52%), wind (26%), biomass (18%) and solar (2%) energy [28].

In the case of Mexico, renewable energies are governed by the regulatory framework for electric energy, based on the requirements derived from climate change. Additionally, in order to promote the development of clean energies in the electricity sector, the use of terms such as “sustainability” and “sustainable industrial development” was encouraged within
the energy plans. In this context, the electricity industry law was also published in 2014, which established the implementation of clean energies within the electricity generation processes. Additionally, the National Energy Control Center (CENACE) was created. This institution was in charge of the auction of clean energy certificates in order to promote their use [48].

Additionally, the existing interest of Latin American governments in implementing research projects focused on the development and evaluation of suggested frameworks for technological school activities is highlighted. An important objective is to promote the study of technology related to renewable energies in the academic environment and from both a technical and sociocultural perspective [46]. Through these policies, it is possible to take advantage of the great interest that non-traditional renewable energies have awakened in developing countries. Furthermore, educational initiatives at all levels are essential to inform the general public about these technologies and facilitate their adoption in the near future [47].

4.4. Energy Potential in Latin America

In addition to the progress made in Latin America in the generation of clean energy in its territory, there is potential not only to continue growing in this area, but also to promote the exploitation of other renewable energy sources. On the one hand, Chile is committed to reducing harmful gas emissions per unit of Gross Domestic Product (GDP) by 30% by the year 2030, in addition to planning for 70% of the energy available in its electricity grid to be obtained from renewable sources by the year 2050 [53]. Similarly, it plans to have acquired 560 GW of installed capacity in offshore wind energy by 2040 [23]. As for Peru, there is interest in increasing the share of overall energy produced by solar PV by up to 13% by 2030 [11]. In Bolivia, the share of electricity produced domestically is projected to increase to more than 20% by 2040 [67]. In Cuba, it is planned to continue with the modification of its energy matrix to obtain 24% of electricity from renewable energy sources by 2030 [68].

Countries such as Honduras also have excellent potential to take advantage of solar energy, as have many of its neighboring countries, although their performance in this field does not currently compare to that of the leading countries in renewable energy generation. In this country, solar energy is mainly used for self-consumption in the industrial and commercial sector, although it seeks to supply electricity to the national grid through solar photovoltaic systems [69]. Panama, in turn, seeks to take advantage of this renewable source given that it has greater solar than wind potential in its territory, with 4.96 kWh/m² day. Studies focused on determining the feasibility of establishing Zero-Energy Districts (ZED) that have reduced energy consumption thanks to characteristics such as the use of natural ventilation and that can receive the remaining energy required through solar panels [70].

Even renewable sources that have been providing electricity to Latin America for decades, such as hydroelectric power, continue to generate interest in their expansion and improvement. There are evaluations in countries such as Venezuela that sought to determine the technical and economic feasibility of a small hydroelectric power plant on the Valle River, in addition to conducting sensitivity, risk and emissions analyses. From this study, very encouraging economic statistics were obtained, with an internal rate of return of 280.3% and a payback period of 0.4 years. Even countries such as Venezuela that rank very low in the ETI can pursue their nation’s energy development towards cleaner electricity generation by taking advantage of available natural resources [38].

On the other hand, one way available in this region to generate electricity through renewable energies that has not yet been adequately exploited is the use of biomass for biogas generation. In Latin America, electricity generation by biogas produced 765 MW by 2022, an energy figure much lower than that obtained from the main renewable energy sources used, such as solar photovoltaic and wind power. In countries such as Ecuador, there is the possibility of obtaining residual biomass, i.e., from the food waste of the inhabitants of regions such as Guayaquil, which is considered an alternative energy resource
to fossil fuels. In addition, it is considered that the amount of biogas to be produced can be
determined from the energetic valorization of the organic substrate in such waste [39].

Similarly, Peru is also a country with large amounts of waste generated by its popula-
tion. Currently, one person in Peru produces one kilogram of waste per day, an amount
that is inefficiently measured and managed by district municipalities. This presents an
opportunity to take advantage of the energy potential of such waste and obtain residual
biomass through sustainable integrated models [42]. Additionally, there is forest biomass,
which can be extracted in Ecuador from Piptocoma discolor, a fast-growing native species
from a secondary forest located in the Mera canton, ideal for a sustainable forest due to its
prevalence in the Ecuadorian Amazon and Latin America [40].

Another way to produce biogas is through the use of livestock wastes such as those
generated by these activities in the province of Buenos Aires [6,41]. This country, in turn,
has a great potential for obtaining biomass from agro-industrial waste, as the forestry
industries in Argentina are the generators of the largest volume of waste in this country [13]
This possibility is also observed in countries such as Cuba, which produces a large amount
of solid waste from its agricultural activities, including rice straw, sugarcane straw, corn,
beans, husks and parchment coffee, among others. These residues can be used in digesters
for the production of biomethane, with the potential to supply up to 18% of the total annual
energy generation of this country [68].

Apart from biogas, there is great potential in this region to take advantage of other
renewable energy sources. Colombia’s great potential for the use of geothermal energy, due
to the volcanic activity of the Nazca tectonic plate is highlighted, and its policy implemented
to promote sustainable development has already created the conditions for the exploitation
of geothermal resources. The country has already launched exploration initiatives in places
such as the Nevado del Ruiz volcano, the Tufio–Chiles–Cerro volcanic system, the Azufral
volcano and the Paipa geothermal area. However, technical, infrastructure, legal and
institutional challenges continue to act as obstacles for the proper functioning of these
projects [19]. This type of project requires specific legislation that focuses on controlling
the expansion of the electricity generation sector, direct industrial uses and heating derived
from the use of geothermal resources. In this regard, actions taken by countries such as
Ecuador for the development of risk management strategies to address problems such as
the high financial risk factors in this industry and the need for significant initial capital
investments are highlighted [20].

In the case of Brazil, although it is already a power in Latin America in the generation
of renewable energy, it has the potential to begin to take advantage of the conversion of
ocean energy that could be obtained from its extensive coastline into electricity, although
in-depth studies have not yet been carried out [9]. This country has recently announced the
incorporation of offshore wind energy into its electricity system through the installation of
offshore wind farms in the north of the country. In addition, there is the case of Chile, which
has a coastline of more than 6000 km but does not have projects to implement offshore
wind farms since these involve higher costs and greater technical complexity compared to
other renewable energy alternatives [23]. Other countries such as Colombia also present
opportunities to develop the technology to take advantage of offshore wind energy, mainly
due to advantages such as the high wind speed potential on their Caribbean coasts [45].

Chile, being a Latin American power in the production of green hydrogen, has the
potential to continue growing and become a leading producer of this element thanks to
the abundant resources it possesses. In this context, this country is betting on the joint
use of wind and solar energy for the production of green hydrogen at competitive prices
with minimal environmental impact, in addition to setting the goal that green hydrogen
will represent 20% of the total energy matrix of this country [71]. Similarly, Brazil has
the potential to become a major hydrogen exporter in order to further reduce the impact
of climate change and the emission of greenhouse gases in its territory, in addition to
generating jobs and creating demand for skilled labor. Brazil, Chile and Latin America in
general have the capacity to become a green-hydrogen-supplying region for the world [5].
5. Discussion

This systematic review has explored the current situation of renewable energy use in Latin America, which has grown considerably in recent years to reach an energy production of 312.22 GW according to IRENA figures. However, from this, it can be seen that the energy performance of this region continues to be lower than that of other parts of the world, such as Europe, with a production of 647.39 GW in 2022, or Asia with 1455.71 GW in the same year. Even the energy performance of the United States stands out, with 325.39 GW, which means that this country on its own generates a greater amount of energy from renewable sources than the Latin American region as a whole.

Although renewable energy sources are being used in greater proportion on other continents than in Latin America, it is possible to highlight the progress in the energy transition in the countries that comprise this region through actions such as the use of photovoltaic panels in different Latin American countries, which reduces the cost of electric energy and, above all, reduces the emission of greenhouse gases [7,8,53,54,57]. In recent decades, climate change has driven this transition, both in this region and in the rest of the world, given the concern it has generated and the problems it brings for humanity [10,52,59].

Some countries in Latin America have naturally favorable conditions for the implementation of infrastructure to take advantage of photovoltaic energy. Western South America is one of the six major global horizontal irradiation (GHI) hotspots, along with regions such as the Arabian Peninsula and Australia [72]. Figures presented in the Global Solar Atlas place Chile as the Latin American country with the highest practical long-term solar energy production potential, with 5.36 kWh/day on average, followed by Bolivia and Mexico. However, Latin America has been unable to take full advantage of it to date, as they have faced difficulties such as high initial investment costs and lack of knowledge of this technology, among others [56].

In order to disseminate the use of renewable energies, it is important to develop non-conventional energy projects in Latin America, especially to support energy growth in rural areas [58]. On the other hand, the use of onshore wind energy for electricity generation is observed in different Latin American countries, achieving a decrease in the emission of environmental pollutants. In several countries, there is also evidence of the construction of wind farms, thereby reducing the cost of energy [1,4,60,61,63–67].

From the studies compiled, it is possible to affirm that non-conventional renewable energy sources such as solar and wind sources are the most used and studied in Latin America, with a marked difference compared to other alternatives available in the region such as biogas, geothermal energy or green hydrogen. Similar studies carried out worldwide show that this interest in accelerating the energy transition is shared by other regions of the world, although with different approaches and progress. When comparing the progress of Latin America with respect to the implementation of renewable energies with other parts of the world, it is possible to observe a considerable distance between the current state of the nations that make up the region and countries such as Spain, Canada, Germany, Japan or the United States, which are much more developed in the use of energy sources such as solar, hydroelectric or wind sources [73].

In addition, there are similarities with respect to the energy situation in Latin America compared to other regions of the world, such as Southeast Asia. Both are regions with untapped potential in terms of renewable energy sources, although they have already begun to take action to make the transition to more clean energy generation. Similarly, they face challenges in terms of costs and awareness on the part of the public [74]. From a global point of view, it is observed that Latin America is within the trend of other countries, which, in general, show a greater preference for energy sources such as wind or hydroelectricity [75,76].

Similar studies have determined that an energy transition to renewable-energy-based production is a complex process that requires long-term planning focused on a series of aspects such as capacity, costs, regulatory barriers and infrastructure, among others. Given the different realities between countries, each country requires specific planning according
to its current situation [73]. In this context, the role of Europe as one of the main regions focused on research and implementation of clean energy is highlighted [76]. In contrast to the state investment in renewable energies observed in Latin America, European countries have a greater financial capacity of their own, which gives them greater stability and facilities to make developments in this field [14].

Additionally, the high level of European education has been shown to have a positive impact on renewable energy consumption, as public awareness of environmental issues to accelerate the transition to renewable energy, in addition to promoting foreign investment through support measures such as the establishment of tariff exemptions, is viable [77]. As a result, it is advisable that Latin America seek to migrate to new models and regulatory frameworks that allow greater participation of the private sector in the development of renewable generation projects. In addition, the importance of strengthening its educational system is evident, as it is a useful tool to promote this energy transition [14].

6. Conclusions

From the systematic review carried out, it has become evident that there is an interest in Latin America in adopting renewable energies as a response to the increase in energy demand and the use of fossil fuels experienced in recent decades. Latin America has the potential to take advantage of solar, wind, biomass, geothermal and other energy sources. In addition, there is a clear desire in the region to counteract the effects of climate change on the conservation of available natural resources and the survival of future generations. Through renewable energies, it is possible to generate electricity in a cleaner way without directly polluting the environment, in addition to taking advantage of virtually inexhaustible and easily accessible energy sources.

This major project being implemented in this region also requires the establishment of energy standards and plans to promote and regulate the use of renewable sources, as well as greater education on these issues, in order to generate awareness and facilitate the adoption of sustainable practices. At the same time, it is emphasized that this transition to cleaner energy sources needs to be complemented by other factors since, at the same time, greater energy efficiency must be promoted, as well as responsible electricity consumption. The importance of combating climate change is emphasized since, among its many adverse effects, it is capable of affecting the use of some renewable sources, such as solar power, wind and even hydroelectric power plants.

Brazil stands out as one of the countries with the greatest progress in clean energy generation. However, despite the progress made in Latin America in the adoption of renewable energies, especially in the use of sources such as solar and wind sources, there is still a marked gap with respect to the world’s leading countries in this field. Latin America faces challenges in terms of high initial costs, lack of knowledge and dissemination of these issues and a lack of projects in rural areas and other things. Considering the existing potential, as well as the current interest in these new technologies, it is important for this region to observe the plans implemented in other parts of the world that may contribute to its energy development in the future, such as a greater participation of private companies or the European strategies currently applied.

Although there is evidence of efforts to take advantage of renewable energy sources in Latin America, this is still not enough to mitigate the effects of climate change caused by the emission of CO$_2$ into the atmosphere. In view of this problem, there is still a need for greater awareness of the problem of the use of fossil fuels, with the aim of generating awareness in the population and immediate action by the governments of the countries. Collaboration between governments and industry is essential to address this challenge through the use of emerging technologies and the enactment of effective policies to ensure a better future for generations to come through more environmentally friendly energy production.

To improve the understanding and promotion of renewable energies in Latin America, it is important to encourage research on other aspects, such as socio-economic and environmental aspects, as well as comparative issues at the global level. Given that it is important
to know in depth the Latin American reality to make a transition to cleaner energy sources and to understand the impact of these changes on their society, it would be beneficial to carry out future research that explores this impact. Additionally, further studies could evaluate Latin America’s progress in this transition over a longer period to analyze its effects in terms of a reduction in harmful gas emissions or economic growth.

**Funding:** This research received funding from Cesar Vallejo University (Peru).

**Conflicts of Interest:** The authors declare no conflict of interest.

**References**

1. Procópio, F.; Gianinni, M.; Vasconcelos, M.; Fidelis, N.; de Azevedo, E. Bigger is not always better: Review of small wind in brazil. Energies 2021, 14, 976. [CrossRef]


5. Asencios, Y. The Importance of Hydrogen for Brazil: A source of clean energy and a path to the production of nitrogen fertilizers. SciELO Prepr. 2022, in press. [CrossRef]


13. Sabbatella, I. economía política internacional de las bioenergías: Avances y límites en el mercado eléctrico argentino. Relac. Int. 2022, 31, 158. [CrossRef]


16. Castiblanco, C. El papel del impuesto al carbono en la transición energética: Una revisión de su aplicación en Colombia. Gestión Ambient. 2022, 25, 102263. [CrossRef]


20. Carcelen, J.; Izquierdo, C. Energía geotérmica en Ecuador, condiciones actuales y necesidad de una legislación específica. Iuris Dicctio 2022, 16, 527. [CrossRef]


Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.