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Green Bonds for Renewable Energy in Latin America and the Caribbean

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ABSTRACT

This paper comprehensively analyzes the overall status of the green bond market in Latin America and the Caribbean (LAC) for the renewable energy sector. Our results show that, in most cases, issuers are non-financial corporations. Also, despite LAC's low perception of transparency, 78% of the volume issued has been externally reviewed. In general terms, the barriers imposed on issuance by local governments, mainly municipal debt ceiling, low credit rating and solvency, limited capabilities to prepare bankable projects, and lack of communication channels between the financial sector and local governments, constrain the green bond market in LAC. Furthermore, although the presence of development institutions that promote the issuance of green bonds in the renewable sector has improved in recent years, it is mandatory to continue making progress in this area. For that purpose, closer cooperation and alliances are essential to share responsibilities and knowledge in LAC.

Keywords: Renewable energy, Latin America and Caribbean, Green finance, Green bonds, Sustainability, Sustainable development goals

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1. INTRODUCTION

The Sustainable Development Goals (SDGs) agenda provides targets aligned with the aims of sustainability-oriented green bond issuers, promoting the joint work between countries to guarantee changes in how development permeates global economies and the planet. In the specific case of green bonds for renewable energy projects (RE), these are framed in SDG 7. However, given their importance, they are cross-conditioned and highly transversal to other SDGs, such as 8, 11, 13, and 17. In fact, these SDGs are also aligned with the aims of green bond issuers in other sectors, such as transport, sanitation, forestry, financial, and agriculture. Furthermore, the Green Bond Principles developed by the International Capital Market Association (ICMA) and the Climate Bonds Initiative

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(CBI) provide valuable guidelines to the market on the main characteristics and requirements for the issuance of green bonds, establishing specific sustainable criteria for different sectors.

In this way, green bonds are progressively becoming more relevant in the design of investment portfolios (Mejía-Escobar, González-Ruiz, and Duque-Grisales 2020). This type of financial mechanism constitutes a sustainability-oriented fixed-income security that accounts for the cost of mitigating the negative consequences of climate change. Thus, green bonds raise capital primarily to fund environmentally friendly projects that reduce greenhouse gas emissions using low-carbon financing approaches (Tu, Rasoulinezhad, and Sarker 2020). Therefore, green bonds give financial support to the 2°C temperature target of the Paris Agreement (Tolliver, Keeley, and Managi 2020a) and promote RE in order to meet the climate agendas promoted by the United Nations in the SDGs (Richter et al. 2021, Tolliver, Keeley, and Managi 2020b).

Remarkably, there is evidence of a green premium or ‘greenium’, which is defined as the difference between the yields on a plain vanilla bond and a green bond with similar characteristics. Thus, according to MacAskill et al. (2021), there is consensus in the literature about the existence of a green premium in 56% of the studies on the primary market and 70% on the secondary market. In fact, different studies consider the green premium as one of the most important characteristics of green bonds (Ravina 2022, Agliardi and Agliardi 2019; Gianfrate and Peri 2019; Zerbi 2019; Hachenberg and Schiereck, 2018), especially for those issuances carried out by governments/municipals and firms with investment grade. These findings could be partly explained by credit and risk profiles that are far removed from conventional issues, which translate into effects on the relevant risk-return characteristics for investors, as noted by Kempa and Moslener (2017) and Zerbib (2019).

At this point, it should be noted that a key characteristic of green bonds relative to plain vanilla bonds is its label, that is, the different requirements that allows the issuer to label the issuance as green. According to Li et al. (2022), labels allow bonds that meet green criteria to receive a green flag as identification. In this context, CBI and ICMA play a pivotal role as leaders in the publishing of specific guidelines for market players, which include mainly third-party assessors, issuers, investors, and regulators in order to help to reduce asymmetric information (MacAskill et al. 2021), mitigate adverse selection, and reduce the liquidity premium (Febi et al. 2018). In this regard, CBI is one of the key players in the green market, providing certification schemes designed as an easy-to-use tool for market players to prioritize and develop investments that truly address climate change issues (Climate Bonds Initiative 2022). In Europe, supported by the Technical Expert Group on Sustainable Finance, the EU Green Bond Standards provide voluntary standards that help the public and private sectors raise funds to finance large-scale investments that meet sustainability concerns (European Commission 2019). On the other hand, the ASEAN Green Bonds Standards support sustainable growth and align the interests of investors, issuers, and regulators from Southeast Asian Nations. Regarding LAC, although there are no common standards across countries, the Climate Finance Advisory Council of Mexico has developed the Green Bond Principles MX, which are intended to generate common standards to guide green bond issuers in the Mexican market, as well as provide investors with certainty about the expected environmental benefits of investments financed with the funds raised (Climate Finance Advisory Council 2018).

Hence, the label leads issuers and investors to consider other attributes—namely, Environmental, Social, and Governance (ESG) attributes—in addition to those purely related to financial matters in making their economic decisions (Richter et al. 2021, Sartzetakis 2021). This fact explains why green bonds are increasingly positioned in the energy sector (McInerney and Bunn 2019, Sangiorgi and Schopohl 2021) and, more specifically, in the wind and solar energy sectors (Tolliver, Keeley, and Managi 2020b).

Accordingly, the funds raised by the issuance of green bonds are used mainly in the renewable energy, transport, and building sectors to finance environmental-friendly projects (Richter et al. 2021, González-Ruiz et al. 2019). Due to the relevance of these sectors, recognized institutions and researchers have conducted several studies. The main research topics cover the analysis of investment opportunities in green infrastructure, financing of projects in agriculture, water, transportation, green buildings, and energy efficiency in real estate (Gianfrate and Peri 2019, González-Ruiz et al. 2019, Ng and Tao 2016, Maltais and Nykvist 2020).

However, regardless of all the advances in the study of green bonds, we identify a gap in the analysis of the dimension and determinants of green bonds in the renewable energy sector in the Latin America and the Caribbean (LAC) region, which plays a pivotal role in the renewable energy scene worldwide. To the best of our knowledge, no study in the current literature has provided an in-depth analysis of the characteristics of green bond issuances for this type of project in LAC. To help bridge the identified knowledge gap, this study aims to analyze the overall state of the green bond market in LAC for the renewable energy sector.

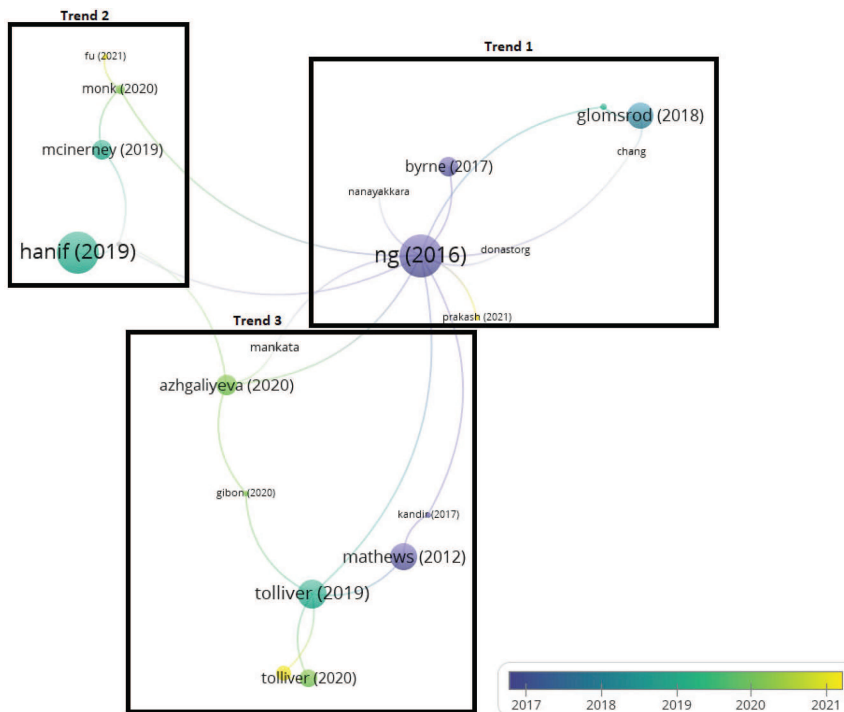
This paper contributes to the previous research in the following ways. First, we provide insight into the role of the green bond market in financing RE. In order to gain a better understanding of this topic, the most representative countries and projects in terms of volume issued are examined, allowing issuers and investors to broaden their knowledge of the opportunities available in financing RE through green bonds and benefit from the experience and advances of others. Second, this study provides essential information on the difficulties in financing the renewable energy sector in LAC, where research on this topic is scarce. Therefore, our results and conclusions can be useful for policymakers and investment managers to develop new public policies that contribute to structuring investment portfolios that include sustainable financial products, such as green bonds.

This paper is organized as follows: Section 2 provides the theoretical background. Section 3 describes the data and methods. Section 4 analyzes the results. Finally, in Section 5, the conclusions, contributions, and further research are presented.

2. LITERATURE REVIEW

Although research on green bonds has increased in the last years, specific analysis of sectors is scarce, especially in developing countries and regions such as LAC. Based on previous research on green bonds in the renewable energy sector, the main contributions are related to risk, energy efficiency, carbon emissions, and profitability. Figure 1 shows the most representative studies on green bonds and renewable energy, based on citations obtained from Web of Science (WoS) and Scopus. Accordingly, three well-defined research development trends are identified in the academic literature.

A first research development trend focuses on financing issues. Thus, Ng and Tao (2016) explore the reasons for the financing gap of RE in Asia and suggest green bonds to address this matter. On the other hand, Glomsrød and Wei (2018) state that large banks and institutional investors have risen to prominence, with the potential to significantly contribute to a low-carbon transition. Byrne et al. (2017) conducted a series of simulations using multivariate analysis and Monte Carlo simulation to analyze solar city possibilities for Amsterdam, London, Munich, New York, Seoul, and Tokyo. In this work, green bonds are mentioned as a financing innovation that could help to address large-scale capital investments for green purposes. Donastorg, Renukappa, and Suresh (2021) analyze the new trends in renewables for the Dominican Republic and identify gaps in financial areas. In this context, new financial trends such as green bonds are encouraged.

Figure 1: Most representative studies on green bonds and renewable energy based on citations

Nisha and Madhvi (2021) concluded that India needs to develop a national framework for green projects in which green bonds play a pivotal role as a financing option to meet SDGs. Accordingly, green bonds can help promote financing for a wide range of sustainable energy systems, such as large solar thermal, photovoltaic, and wind power systems, as well as investments in network infrastructure for electricity, district heating, hydrogen, charging stations for battery electric vehicles, and energy efficiency, among others (Haas et al. 2021).

A second research development trend is related to energy transition. In this line, Hanif, Aziz, and Chaudhry (2019) explore the impact of non-renewable and renewable energy on carbon emissions in developing Asian economies. The authors conclude that renewable energy helps control carbon emissions, while the consumption of non-renewable energy contributes to increased carbon emissions. McInerney and Bunn (2019) state that sustainable financing mechanisms are critical for the energy transition's success. For this reason, the green bond, as one of the most important financial eco-innovations, is helping the transformation towards green banking and the development of green products (Mejía-Escobar, González-Ruiz, and Duque-Grisales 2020). In the same line, Monk and Perkins (2020) conclude that new financial products are required to finance the low carbon energy transition. In this context, although green bonds help reconcile sustainability issues with fixed-income markets, it should be noted that both the effectiveness of green bonds in financing RE and risk management procedures in emerging economies are still aspects scarcely studied in the literature.

A third research development trend studies the relation between green bonds and SDGs. Tolliver, Keeley, and Managi (2019) explain that, although green bond markets are growing significantly, improved post-issuance reporting is strongly recommended. Additionally, the authors provide insights for future green bond applications in order to widen SDGs agendas. Gibon et al.

(2020) study the life cycle assessment (LCA) of RE financed through green bonds. The authors conclude that green bonds pose additional methodological challenges for LCA compared to current reporting practices, as well as increased data requirements. In fact, reporting and post-reporting tasks are becoming one of the most challenging aspects of financing via green bonds.

3. DATA AND METHODS

We perform all calculations using a self-generated database comprising information on all green bond issuances carried out in LAC, from 2014 to 2020. Our database includes information on the amount issued, number of operations, type of issuers, currency, use of the proceeds, and maturity, among other indicators. The database has been created based on information from the CBI website, the recently launched Green Bond Transparency Platform (GBTP) of the Inter-American Development Bank, and Thomson Reuters Refinitiv™. In particular: (i) information on amounts issued and the number of operations was obtained from CBI, specifically from the Market Intelligence section of its website, (ii) external reviews, sectors, and types of issuers were obtained from GBTP, specifically from Bonds section of its website, and (iii) tenors and sectors were obtained from Thomson Reuters Refinitiv™, specifically from Fixed Income App of its platform. Thus, our dataset includes 60 issuers with more than USD 9.9 billion in outstanding issues in LAC countries.

4. RESULTS AND DISCUSSION

In this Section, we comprehensively study the dynamics and characteristics of green bonds in LAC, as well as the most significant issuances by amount issued and environmental impact. All calculations in the figures and tables below are made considering the amount issued and the transactions in each year in current dollars.

4.1 Country summary

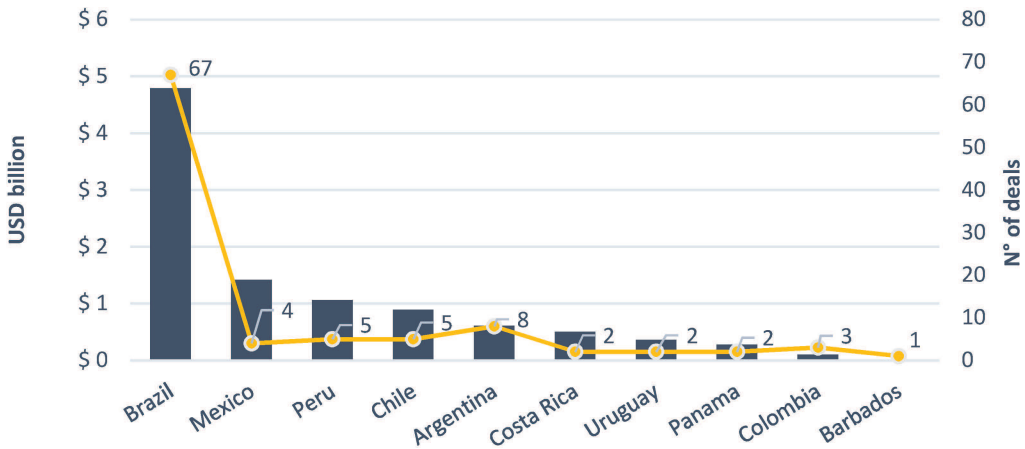
The analysis of LAC's green bond market from 2014 to 2020 indicates that only ten countries have issued green bonds for financing RE. This translates into low participation, representing less than a third (30%) of the potential issuing countries in LAC. As shown in Table 1, Brazil dominates with 47% of the total amount issued in the period under study. Mexico follows with 14%, and Peru is third with 10%, where the following five countries represent an average share of around 5%. The distribution is even more concentrated when we consider the number of bonds, with Brazil representing 67%, Argentina 8%, and Peru 5%, among the first three countries.

Table 1: 2014–2020 LAC country-level RE green bond market outlook

Country	Total amount issued (USD m)	Share	Number of bonds	Number of issuers	Main issuer type	Most active year	Amount externally reviewed	Main Technology (by volume)
Brazil	4.789,9 m	47.91%	67	38	Non-Financial Corporate	2019	90%	Multiple
Mexico	1.409,7 m	14.10%	4	2	Development Bank	2015	100%	Multiple
Peru	1.056,0 m	10.56%	5	4	Non-Financial Corporate	2019	41%	Transmis. and distr.
Chile	887,0 m	8.87%	5	4	Non-Financial Corporate	2019	51%	Multiple
Argentina	609,2 m	6.09%	8	4	Local Government	2020	99%	Wind
Costa Rica	503,5 m	5.04%	2	2	Development Bank	2016	75%	Multiple
Uruguay	361,4 m	3.61%	2	1	Non-Financial Corporate	2020	30%	Solar
Panama	278,1 m	2.78%	2	2	Non-Financial Corporate	2020	6%	Wind
Colombia	102,2 m	1.02%	3	2	Non-Financial Corporate	2020	100%	Transmis. and distr.
Barbados	1,5 m	0.02%	1	1	Financial Corporate	2019	100%	Solar
Total	9.998,5 m	100.00%	99	60			77,84%	

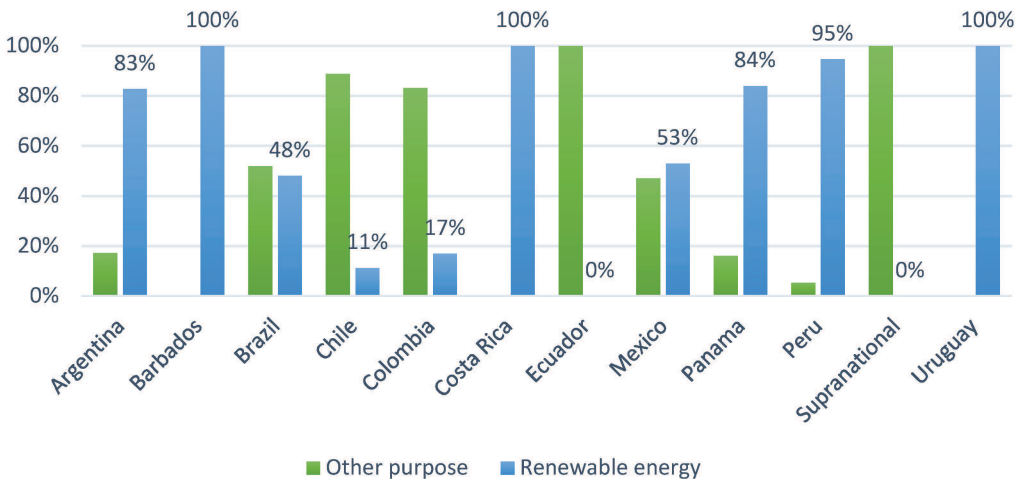
Figure 2 depicts the total amount issued and the number of transactions by country. As shown, with USD 4.7 billion issued, Brazil more than triples the second country with the highest volume (Mexico). Furthermore, the top three countries achieve over USD 7 billion issues, while the rest of the countries achieve issues in the range of USD 100-900 million. Excluding Brazil, where the number of issuances is much higher than in any other country in the region, the average number of green bond transactions is 3.5 agreements per country. In total, LAC has obtained funds via green bonds worth USD 9.99 billion (see Table 1).

Figure 2: RE green bond transactions and total amount issued between 2014 and 2020



As shown in Table 1, from 2014 to 2020, 99 transactions and 60 issuers of green bonds for RE have been identified. The leadership of the largest economies and financial markets in the region—which correspond to the countries with the highest GDP in LAC—is remarkable. Moreover, with records up to 2020, the proportion of bonds destined for RE is the majority in all countries except Chile, Colombia, and Ecuador, as shown in Figure 3, according to data gathered from CBI and GBTP.

Figure 3: Composition of green bonds resource use in LAC by country



At this point, it should be noted that, although countries exhibit different degrees of ambition, level of detail, and formalism in their development plans and climate change policies (United Nations 2021, International Finance Corporation 2019), a common factor is the importance of investments in infrastructure and the promotion of reduced dependence on fossil fuels through investments in RE (CEPAL 2017, Bárcena et al. 2018). These aspects are crucial since fossil fuels significantly impact the region's greenhouse gas (GHG) emissions (CEPAL 2017, Bárcena et al. 2018, Stern 2006, Ritchie and Roser 2020).

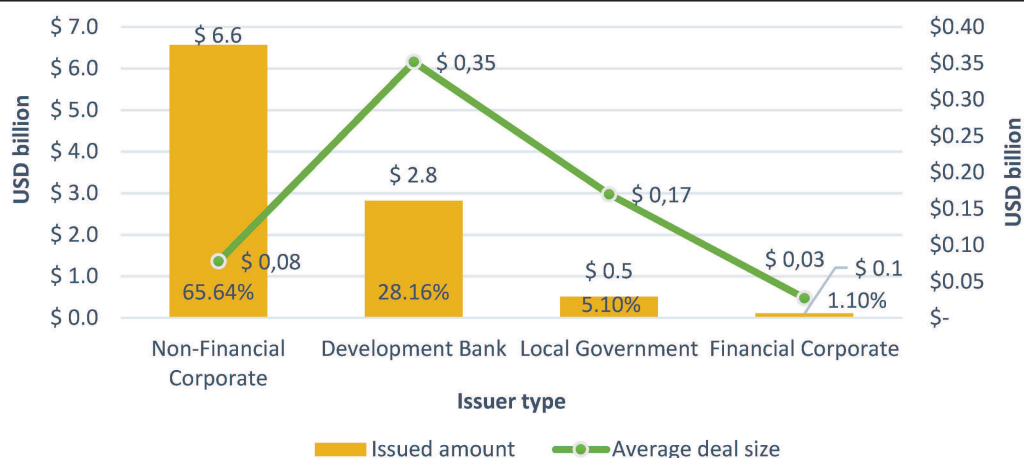
Hence, our results suggest a trend towards the green bond market in LAC for RE, with LAC countries allocating 57.54% of the funds raised via green bonds to renewable energies, according to the data represented in Figure 3. However, this trend varies markedly across countries. In fact, at the country level, Figures 2 and 3 show that the differences are evident, ranging from countries with a high presence of green bonds for RE due mainly to the small number of agreements, such as Barbados or Costa Rica, to those with a long history and significant participation, such as Brazil or Mexico. On the other hand, Colombia and Chile exhibit discreet share in green bonds for RE, as shown in Figure 3.

New regulatory and guideline frameworks intended to increase private sector participation through public auctions largely explain the importance of RE green bonds in the case of the most active countries (Brazil, Mexico, and Peru). Thus, from 2004 to 2019, Brazil increased its installed capacity from 86.6 GW to 165 GW, of which 45% corresponds to renewable energies, such as biomass, solar, and wind (Englobally Latinoamérica 2020). In this context, the issuance of green bonds has allowed investors to access new financial schemes especially oriented to this type of investment. On the other hand, the Climate Finance Advisory Council of Mexico has been particularly active in establishing procedures intended to generate common standards to guide players, increasing transparency in the Mexican market (Climate Finance Advisory Council 2018). Regarding Peru, supported by MÉXICO₂ Plataforma Mexicana de Carbono, A2G Climate Partners, and the Lima Stock Exchange with funding from the British Embassy, this country has developed the Green Bonds Guide aimed at boosting the creation of the Peruvian green bond market. This guide allows market players to easily access the requirements, the applicable regulatory framework, and knowledge about the role of the green bond market, which has contributed to increasing market transparency (MÉXICO₂ 2018).

4.2 Issuers profile

Non-financial corporations have consolidated as the predominant type of issuer in LAC, as shown in Figure 4, which represents the total amount issued by type of issuer and the average size of operations, using the data gathered from CBI and GBTP. This is also the case for the renewable energy industry, where corporations are the prevalent investor type, accounting for 65% of the volume and 84.85% of the deals, consistent with the predominant ownership type of companies in the region.

However, it should be noted that, according to CBI and GBTP data, until 2020, 4 of the 10 issuing countries concentrate their issues in a single issuer. For 7 of them, more than 90% of the funds collected come from a single type of issuer. The largest number of different issuer types in the RE sector is observed in Brazil, which has issuances from all types of issuers except local governments. However, it should be noted that non-financial corporations account for the vast majority of these issues (94%). Furthermore, only one country has no non-financial corporate issuances, while only Argentina has local government issuances.

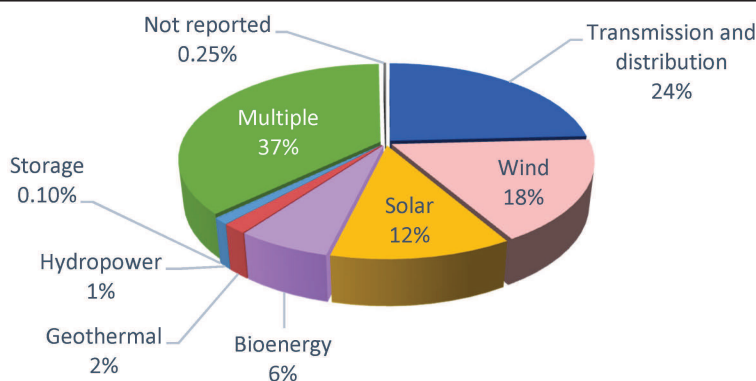
Figure 4: Issuance of green bonds by type of issuer

Importantly, access to energy from non-fossil sources is recognized as a source of progress in competitiveness, jobs, and development (Ng and Tao 2016). However, looking at the full spectrum of eligible activity categories, there are relatively few issuances by local governments and government-backed entities in LAC. Nevertheless, when we particularize the analysis to RE, the results are significantly different, with development banks and local governments being the second and third largest issuers, respectively, with 33.26% of the value. Moreover, it should be noted that these issuers reach this importance even though they represent only 12% of operations and come from half of the issuing countries.

Regarding the distribution between public and private issuers, the share of issuers from the public sector is, in general, 33% of the RE market (development banks 28% + local government 5%). This percentage is higher than that of the broad green bond market (21% excluding sovereigns), which is consistent with the more significant presence of state ownership in utilities than in other businesses. Regarding the ownership structure of the issuers, we observe a relative parity between public and private ownership issuers, with weights of 47% and 53%, respectively.

Based on data gathered from CBI and GBTP, Figure 5 shows that green bond funds finance mixed types of RE assets or technologies. The ‘multiple’ category leads with 37%, where it includes those bonds that, at the time of issuance, establish a combined destination of various types of RE assets or simply states that they will be intended for RE. This is followed by transmission and distribution (24%), wind energy (18%), and solar energy (12%), which account for 53% of the funds, and 90% if we include bonds with multiple destinations. However, this allocation of funds varies by country. For example, in Central America, solar energy and wind energy lead, while the other technologies have minority stakes of 6% or less, with few issuances and low amounts that are rather expectations than the rule. Regarding transmission and distribution, this category is led by players from Brazil, Peru, and Chile, with transactions of significant amounts, such as those of ISA CTEEP, Consorcio Transmantaro, and Celeo Redes de Chile.

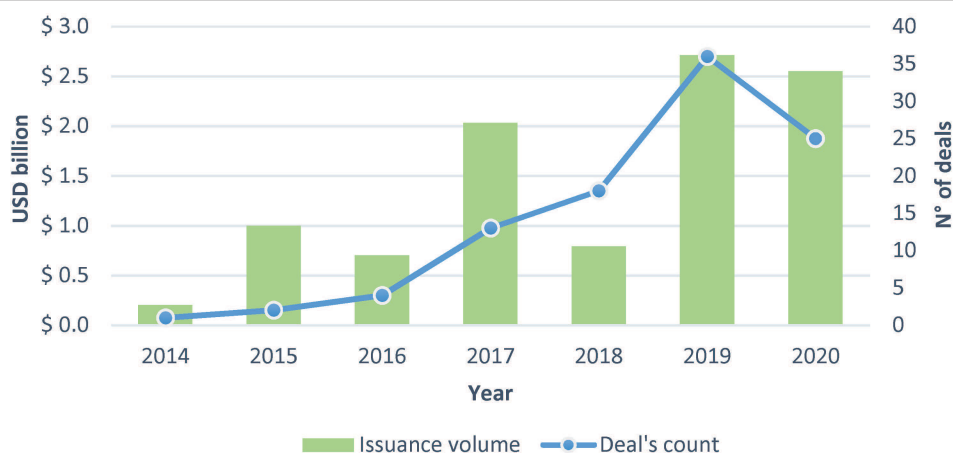
Regarding the relationship between the type of issuer and sector, while in general, the issuers of the energy and bioenergy sector concentrate almost all of the issues destined to a certain type of asset, the rest of the issuers usually choose not to limit the spectrum of eligible projects and define a use in multiple renewable energies. In this regard, it should be noted that, although the predefined use of funds is not mandatory in issuing these instruments, it is considered an inducer of greater transparency and scrutiny that, in turn, leverages investor interest.

Figure 5: Amount issued via green bonds in LAC by sector

Remarkably, public sector issuers—including development banks—mainly finance RE. In this regard, it is generally agreed that development banks, through their initiatives undertaken within the framework of sustainable finance, stimulate market growth and highlight the benefits of financing climate solutions via green bonds (Climate Bonds Initiative 2021). This fact is supported by observing the evolution of the amounts issued by type of issuer. Thus, while development banks have made their most significant issuances in the first years of the market's history, corporate issues have increased from low to high and registered their highest values in the last three years, with issuances exceeding USD 2 billion in 2019 and 2020.

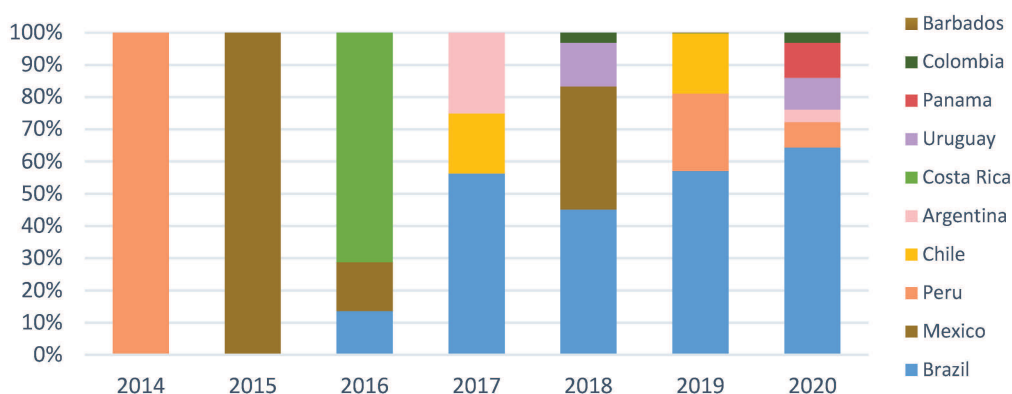
4.3 Market evolution

Essentially, in recent years, the market trend has been growing. Just as 2019 was a record year for the region's overall green bond segment, it was also a record year for renewable energy, as shown in Figure 6. In particular, according to the volumes represented in Figure 6, this year represents 27.14% of the total amount issued since 2014. The year 2020 follows closely with 25.52% but does not reach the amount issued in 2019 due to the distortions in global and regional investments caused by the pandemic (Climate Bonds Initiative 2021).

Figure 6: Amount issued and number of deals in the green bond market for RE in LAC

Remarkably, despite the decrease in volume in 2016, 2018, and 2020, the market has witnessed year-over-year transaction growth, decreasing only 30% in deals during 2020. However, it is worth mentioning that 2020 is the year with the greatest variety of countries and the second in the number of agreements and diversity of issuers. Regarding specific countries, Brazil has steadily consolidated the evolution at the country level since 2016. On the other hand, while in 2019 and 2020, Mexico and Central America have not maintained the importance of previous years, Peru has re-emerged with different issuances these years after being inactive since 2014. In the rest of the countries, there is great intermittency and little continuity in green bond issuances, as shown in Figure 7, which represents the importance of each country each year, by volume, as a percentage of the total amount issued.

Figure 7: Progress of the amount issued via RE green bonds in LAC by country



Until 2020, there is a growing positive perception in LAC of the contribution of green bonds as a financial mechanism that helps to expand investments with an environmental impact. This partly explains that the introduction of climate policies and related initiatives, especially around green finance, has grown significantly in LAC in recent years. The growth potential and expectations generated by investment in renewables have made it a priority for governments, multi-stakeholder agencies, and key players in the green bond market, such as the CBI (Climate Bonds Initiative 2021), primarily driven by the spillover effects on employment, the fight against poverty, and the viability of other fields of the SDGs agenda.

Additionally, renewable energies have been greatly benefited by the notable decrease in installation, maintenance, and last generation costs of solar and wind energy. Along with this, the net metering and capacity auction policies applied in LAC stand out in promoting developers and, therefore, in the search for new forms of financing. For example, in 2018, 17 countries have established regulations on net metering (López Soto et al. 2019), which represents a great boost for distributed generation.

Importantly, although United Nations (2018) estimates that the economic costs of climate change will range between 1.5% and 5% of annual GDP in Latin America if the 2°C scenario is exceeded by mid-century, the cost of adaptation is less than 0.5% of GDP. These costs are relatively high in Latin America due to the high vulnerability, little adaptation, and great sensitivity to disasters and changes caused by climate change. Indeed, although these costs are quite variable across countries, their high value broadly characterizes LAC (Climate Bonds Initiative 2021). In this context, the increased issuances of green bonds are promoting progress in amount, diversity of actors, and frequency of operations. However, it is worth noting that, considering green infrastructure alone, it

is estimated that USD 100 trillion is needed to achieve the global commitments of the Paris agreement by 2030.

Regarding the participation of RE via green bonds, the decrease in the share is evidenced as the market evolves. Proof of this is that, while between 2014 and 2017, the average volume of funds dedicated to RE was 63%, between 2018 and 2020, it amounts to 37%.

4.4 Transaction profile

In general, renewable energy is a priority for companies, which are becoming pillars of a more sustainable economy. In this effort, the features of each transaction are mixed. In principle, a significant part of the transactions was carried out locally (73%). Brazil strongly determines this fact due to the numerous issuances of securities classified as green for meeting the Green Bonds Principles (GBP) but under the figure of incentivized debentures. In any case, international issues lead in volume (52%), followed by local (35%) and private (11%) issues.

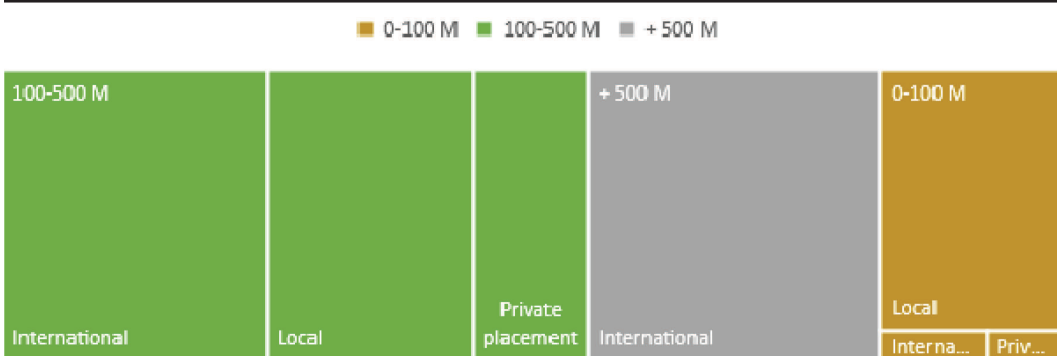
In the case of private placements, multilateral development banks are usually the only investors, but they can also play an important role in the design of the transaction. Hence, multilateral development banks promote better conditions in future market outings, leveraged on the trust they place in these issuers, otherwise unknown and viewed with suspicion by investors, especially considering that these transactions are usually their first issues in the capital markets. Furthermore, a persistent market weakness is the low frequency of public disclosure of information and concerns about the use of proceeds, leading to private placements for RE in LAC, accounting for 12% and 10% of volume and number of operations, respectively.

Remarkably, 5 of the 97 operations of RE carried out in LAC (5%) are of considerable size compared to the others, representing 28% of the total amount. These large issuances are 100% internationally-issued, while for issuances in the range USD 0-100m, 90% is issued locally. Although the USD 100-500m band comprises mainly international issuances, it exhibits a much more balanced distribution, where the benchmark issues are given by Nafin (Mexico), Banco Nacional de Costa Rica (BNCR), and BNDES and FS Bioenergía (Brazil). Figure 8 shows the amounts issued sorted by size and placement markets.

Regarding the currency of issuances, 64% are in dollars, followed by the Brazilian real with 33% of the volume, given its enormous contribution to the total number of operations (65%). The rest of the currencies contribute marginally. Here it should be noted that, when the income from financed projects is generated in a weak currency, international investors incur higher exchange risks and higher costs due to losses resulting from an adverse evolution of exchange rates and budget imbalances. Furthermore, for international investors and large institutional investors, there is evidence of a trade-off between the use of hard currencies and the possibility of obtaining greater resources by increasing the attractiveness of the issuance, especially now that there is a growing appetite in developed markets for emerging green debt (Climate Bonds Initiative 2021). Hence, hedging mechanisms for local currency risk or transaction risk in projects with predominantly local revenues are crucial to mitigate uncertainty. Accordingly, in addition to green bonds, these mechanisms can benefit the entire local financial ecosystem in the region.

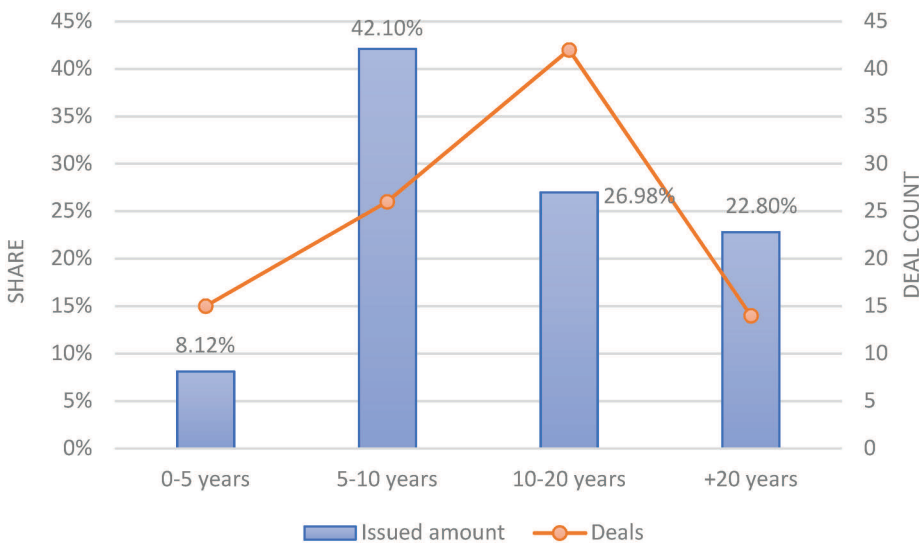
As shown in Figure 9 based on Thomson Reuters Refinitiv™ data, the range of preferred terms of green bonds for RE in LAC is medium-term (5-10 years), with 42% of the total amount. Furthermore, the longest maturities (+10 years) account for half of the issuances, with short-term operations representing only 8%. This distribution of terms is consistent with the large-scale nature of the facilities and the high capital intensity typical in RE projects. Similarly, an interesting finding

Figure 8: Placement market and size of green bond issuance in LAC by amount issued between 2014-2020



is that most medium-term bonds are given by benchmark issues (+500m), which were issued entirely in this band and represented 67,23%.

Figure 9: Renewable energy’s green bond tenors in LAC by amount issued a number of deals



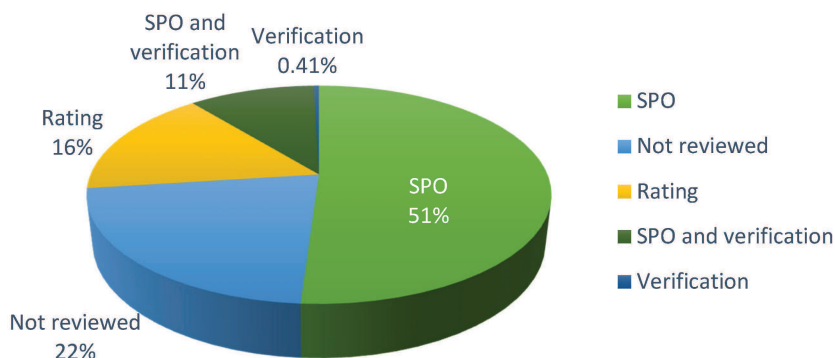
Regarding interest rates, fixed interest rates represent 69% of the volume but only 30% of the transactions. Likewise, the dominant coupon structure is semi-annual payment, agreed for 90% of the amount issued and 84% of the operations.

4.5 Reporting practices

In general, hiring an external reviewer to assess the green credentials of the selected projects is considered a suitable market practice to increase the transparency and clarity of the issuance (Almeida 2020, Climate Bonds Initiative 2021, Ng and Tao 2016, ICMA 2021). In LAC, most reviews are provided by second-party opinions (SPO), as shown in Figure 10, based on CBI and GBTP data. Moreover, in the RE category, 78% of the volume and 58% of the operations have been reviewed under the schemes established by CBI. This level is somewhat lower than that of the total

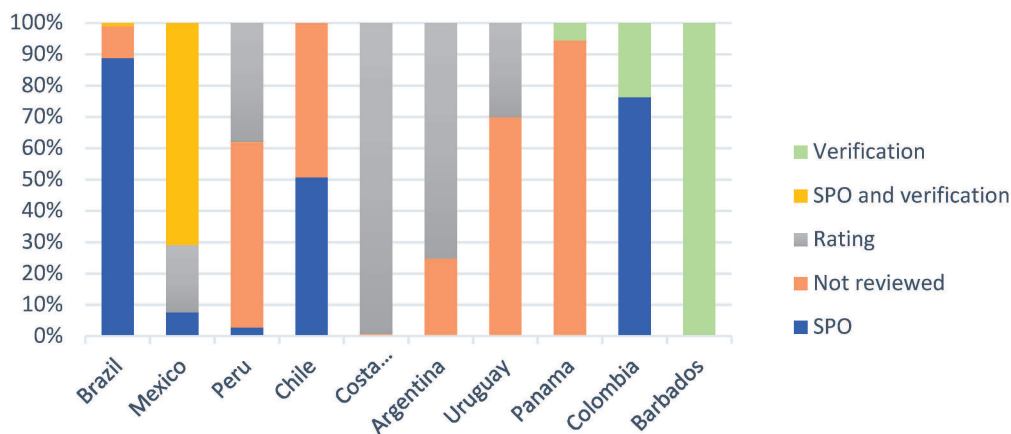
number of green bond issuances in LAC by volume (86.7%) and the number of operations (64%), primarily due to the strong presence of private placements in the RE segment, which are often underwritten without external reviews.

Figure 10: Taxonomy of external reviews of RE green bonds in LAC by number of operations



Remarkably, since 2018 reviews in LAC have increased after a period of decline that began in 2016. As noted by Mejía-Escobar, González-Ruiz, and Franco-Sepúlveda (2021), this pattern is directly attributable to the dissemination of the Task Force on Climate-Related Financial Disclosures (TCFD), GBP, and national voluntary guidelines, especially for largest issues. In particular, an additional 20% increase in revised volume is observed for each increase in deal size, according to the bands described above. Consequently, 100% of benchmark-size issues have an independent approval. Importantly, until 2020, 61% of the green bond universe has received a SPO. This is followed by green or conventional ratings, with 16%, and verifications, with 11%. Although the SPO stands out among the reviews at the regional level in RE, the distribution at the country level exhibits more heterogeneity. In particular, the SPO is the leading review system by amount issued in only three countries, as shown in Figure 11 based on GBTP data. Even external revisions present a high variability across countries, with not reviewed issuances prevailing in Panama, Uruguay, and Peru. As noted, this fact is mainly explained by the concurrence of still very few operations and high relative participation of private placements, which distorts these figures.

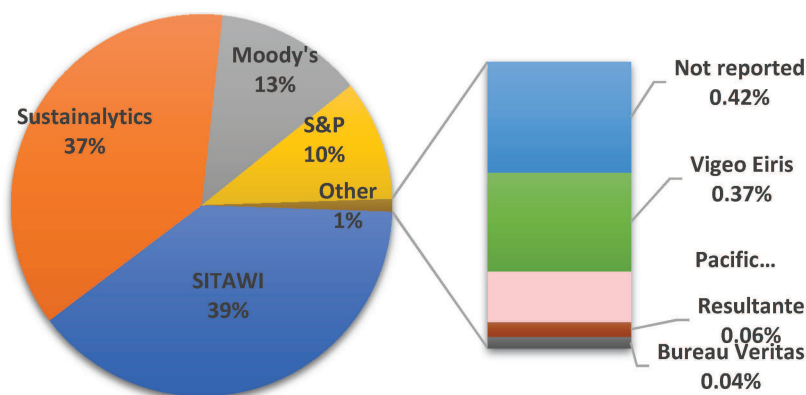
Figure 11: Type of external reviews by country



As shown in Figure 12, based on amounts issued in USD, four external reviewers dominate the market, with SITAWI (39%) and Sustainalytics (37%) competing closely. However, despite the strong competence among the leaders, their geographical concentration is dissimilar. Thus, while Sustainalytics has a balanced presence in five countries (Brazil, Chile, Mexico, Uruguay, Barbados), SITAWI owes its leading role mainly to Brazil (94%) and Colombia (6%). Moody's and S&P hold 23% of the market share, primarily due to their role as the sole facilitators of green ratings.

Regarding reporting over time, post-issuance disclosure strengthens transparency and encourages confidence in the integrity of green bonds to fulfill their mandate on resource use throughout the instrument's life. This is especially necessary for emerging regions with a little culture of public information and low perceived transparency. In this regard, it is worth mentioning that the issuances presented as 'with review' in Figures 10 and 11 represent bonds for which we were able to directly or indirectly find a public report that reflects disclosure practices. Remarkably, there is great difficulty finding such reports since they are not located in sites naturally arranged for this, such as annual reports, hindering the necessary perception of transparency of these instruments. Considering the scope of this study, we did not find a sufficient number of post-issuance reports to allow us to provide information on this aspect in the region. It does not mean they do not exist, but it does mean poor public disclosure.

Figure 12: External reviewers participation in the green bond market in LAC, based on amounts issued in USD



It is important to note that, in general, there are potential distortions in our results due to bonds categorized as 'multiple destinations', as it may be the case that some eligible categories are not part of the final allocation of funds or are insignificant. Although the 'multiple destinations' category can be positive due to the diversification in favor of less addressed sectors, it may lead to a higher ratio of offers and volume destined for the RE category than that registered in the pre-issuance.

This element supports the need to deepen the impact and dissemination of post-issuance reports since they help dispel doubts about the final destination of the funds. Additionally, there are also cases, such as the issue of Banco de Chile, which, in addition to not having an external review, only reports the general category of destination of funds (RE), but not the specific type of assets and eligible projects.

4.6. Representative cases/transactions

Below, we present the three most significant issues by volume issued belonging to the energy sector in LAC, describing their main variables and characteristics.

4.6.1 *Consortio Transmantaro*

The issue consisted of senior unsecured bonds, making it the first transmission company in LAC to issue unsecured green bonds, and the first Peruvian firm to issue green bonds in the international market. The bonds received an external review in the Rating mode by Moody's, obtaining an outstanding result (GB2), highlighting its genuine commitment to sustainability. S&P rating services reviewed the tap issue (S&P Global Ratings 2020). Table 2 shows the main characteristics of this issue.

Environmental eligible projects for Consortio Transmantaro include projects and expenses related to: (i) installation of electricity transmission lines to facilitate the connection of renewable energy sources to the general grid and/or (ii) energy efficiency improvements to transmission infrastructure, including network projects, smart sensors, among others. Good disclosure and transparency associated with the issuance by the company must be recognized, with a microsite in the investor relations section of its website, where information and documents of interest are presented. The company's commitment to sustainability and a comprehensive environmental strategy is also highlighted. The company is dedicated to the construction, operation, and maintenance of high-voltage electricity transmission lines in Peru. As of August 2021, it had 4,369 km of lines, 37% of the market share (S&P Global Ratings 2020).

Table 2: Consortio Transmantaro's green bond characteristics.

Country	Peru
Settlement date	16/04/2019
Amount	USD 400m
Coupon rate	4.70% (Semi-annual payments)
Tenor	15 years (Long term)
Ownership structure	Public holders
Was it a first issuance?	Yes, it was its first appearance in the green bond market. Subsequently, it returned to the market in September 2020 with a tap issue on this bond of half the amount, also directed to renewable energy.
Financed asset	Transmission and distribution projects
Project description	The destination of the resources was defined to refinance the existing bank debt raised to build projects currently in operation (Trujillo-Chiclayo, Machupicchu-Cotaruse, Mantaro- Montalvo, Planicie-Industriales Friaspata-Mollepata, Orcotuna), as well as to finance projects currently in construction that are expected to come into operation in March 2023 (Nueva Yanango-NuevaHuánuco, Mantaro-Nueva Yanango-Carapongo).
Placement market	Luxembourg market
Lead managers	Bank of America, Merrill Lynch, J.P. Morgan

4.6.2 *Celeo Redes Operacion Chile S.A.*

The issuance was aimed at refinancing two transmission lines in Chile, already operational, as well as financing the construction of a new one, all of them awarded to Celeo Redes. This issuance is not only the one with the highest volume by energy companies, but it is also the first issuance for transmission and distribution in LAC. It is the second green bond issuance at the country level and the first by a company in the electricity sector. Its novelty is also being the first green bond of

a structured project in two simultaneous issuances in different markets. Table 3 shows the main characteristics of this issue.

The company did not report having an external review associated with the issuance, despite having a considerable volume and publishing annual sustainability reports since 2016. Despite this, as part of its corporate policy, the company states that it conducts its activities considering socio-environmental aspects, preventing, mitigating, and compensating for environmental impacts (Celeo Redes 2019, 2017). It also highlights its policy based on sustainability, environmental efforts on quality, safety, health at work, social responsibility, and compliance. At present, Celeo has transmission assets totaling 506 km of lines in operation and 503 km under construction, with a total transmission capacity of more than 9,500 MW (Celeo Redes 2017).

Table 3: Celeo Redes's green bond characteristics.

Country	Chile
Settlement date	11/05/2017
Amount	USD 379m + UF 5.4m = USD 600m
Coupon rate	3.35% UF tranche (Semi-annual payments) 5.20% USD tranche (Semi-annual payments)
Tenor	30 years (Long term)
Ownership structure	Private holders
Was it a first issuance?	Yes, it is its first and only green bond issued to date
Financed asset	Transmission and distribution projects The funds obtained in the placement were used to fully prepay the short and long-term liabilities of Alto Jahuel Transmisora de Energía S.A. and Charrúa Transmisora de Energía S.A. Along with this, the funds were directed towards the investments planned to finance the completion of the construction of the Charrúa project and the development and construction of the Nueva Diego de Almagro project.
Project description	
Placement market	Mixed issuance in the US and Chilean markets
Lead managers	BBVA, Goldman Sachs, JPMorgan

The transaction was awarded the Latin America Refinancing Deal of the Year prize. It also obtained other recognitions from specialized publications in the infrastructure and project financing sector, such as the one with the best financing in the electricity sector (Celeo Redes 2017).

4.6.3 *Neoenergía*

The issuance was carried out under green debentures. This mechanism was established by law 12,431/2011 of Brazil to promote and channel investments toward the country's infrastructure sector. For this operation, the reviewer SITAWI approved the transaction under a second party opinion (SITAWI 2020). The bonds were senior unsecured with a plain vanilla fixed coupon. In addition to being the largest issuance in the country in 2019—the year with the highest activity in the green bond market—this transaction has been the largest issuance in local currency (Brazilian real) until 2020. Table 4 shows the main characteristics of this issue.

The company also had a review for its second issuance and a green bond framework published and revised at the end of 2020. Furthermore, it also has a post-issuance external review. These documents are organized by type and year and accessible in a dedicated section on its website, which is good practice that is not widespread enough in the region. The funds obtained through the issuance are used for payments and/or reimbursements associated with commissioning fifteen wind farms, a hydroelectric plant, and ten transmission lines in a share of 16%, 32%, and 52% of the funds, respectively. The portfolio of projects is heterogeneous in their status, including completed, under construction, and planned projects (Climate Bonds Initiative 2019, Neoenergía 2019). The

Table 4: Celeo Redes's green bond characteristics.

Country	Brazil
Settlement date	23/07/2019
Amount	BRL 1,294m (USD 343m)
Coupon rate	Tranche 1: IPCA + 4.07% (Annual payments) Tranche 2: IPCA + 4.22% (Annual payments)
Tenor	Tranche 1: 10 years (Medium term) Tranche 2: 10 years (Long term)
Ownership structure	Private holders
Was it a first issuance?	Yes, it was its first and largest green bond issue. In April of the following year, it again issued a much smaller bond, also aimed at RE, although no longer with multiple uses but with exclusive dedication to transmission and distribution assets, and with a much longer term (25 years).
Financed asset	Assets and projects are financed under the category of multiple types of renewable energy
Project description	Financing for fifteen wind power plants in Paraíba state, ten electricity transmission infrastructure projects in 12 of the 26 regional states, and one hydropower plant in Paraná state.
Placement market	Local issuance
Lead managers	BB Banco De Investimento (Brazil)

company is a subsidiary of the Iberdrola group in Brazil (51%) and is the second energy supplier by population served.

5. CONCLUSIONS

RE green bond market in LAC emerged in 2014, and although slower than the broader green bond market, it has grown an average of 52% annually, with 2019 being the most active year by volume and number of deals. In fact, 38.34% of the universe of green bonds in LAC corresponds to bonds with RE-oriented funds, which makes it the primary sector by use of funds. However, in this period, only ten countries—or 30% of the countries in LAC—have issued RE green bonds. Furthermore, the market is quite concentrated, with three countries accounting for 73% of the resources raised, namely, Brazil (47%), Mexico (14%), and Peru (10%). These results can be partly explained by new regulatory frameworks designed to facilitate the financing of sustainable investments by increasing the participation of the private sector in these countries. In fact, this has allowed Brazil to double its power capacity from 2004 to 2019, where renewable energies have contributed almost half of that increase. In this context, the issuance of green bonds has allowed investors to access new financial schemes especially oriented to this type of investment. Regarding Mexico, the Climate Finance Advisory Council of Mexico has established procedures to generate common guidance standards and increase transparency in the Mexican market. On the other hand, Peru has developed the Green Bonds Guide, which has increased the knowledge about the role of the green bond market and has contributed to increasing market transparency.

Most of the remaining LAC countries have not carried out such explicit strategies to promote RE financing, partly explaining their lesser importance in the period under study. In this regard, our results show little diversity by type of green bond issuer, primarily because almost all of them are concentrated in non-financial corporations. In particular, non-financial corporations have gained importance and registered their highest values in the last three years, exceeding USD 2 billion in 2019 and 2020. These results contrast with those achieved for other developing regions, where the strong presence of commercial banks constitute a hurdle for further development of the green bond market for RE. Thus, Ng and Tao (2016) explain that, except for Singapore, Malaysia, and Thailand, most ASEAN countries still rely heavily on the banking sector, with minimal involvement of the

capital markets. Therefore, the region's low level of financial development is considered one of the leading causes of the RE financing gap. In the same line, Nguyen et al. (2022) also attribute in part of the low importance of alternative financing mechanisms for RE in the Southeast Asian market to the strong presence of commercial banks.

Our results also highlight the small presence of local governments in the RE green bond market. In this regard, our results suggest that regulators should be encouraged to relax barriers to local governments, as they restrict an important green bond niche, as in Brazil (Climate Bonds Initiative 2021). Those barriers include constraints such as the municipal debt ceiling, low credit rating, solvency, limited capabilities to prepare bankable projects, or lack of communication channels between the financial sector and local governments.

Remarkably, the resources allocated to RE by financial issuers are very small, with only 1% of the volume and 4% of the transactions. Consequently, government support for RE green bonds is crucial, as there is extraordinary potential for sovereign issuances not yet present in RE. Apart from this, the regulatory framework and long-term national policies promoting RE in almost all countries is a beneficial stimulus to attract investors encouraged by regulatory stability (Ng and Tao 2016, May and Neuhoff 2021).

Despite the low perception of transparency in LAC, 78% of the volume issued for RE and 58% of the operations have been externally reviewed. In any case, these values are slightly lower than the broad green bond market due to the high incidence of private placements. Likewise, larger issues are more likely to get some external review. Furthermore, second-party opinion remains the preferred type of review with 61% of the universe, followed by green ratings (16%) and verifications (11%). Remarkably, we have not found a sufficient number of post-issuance reports to allow us to provide information on this aspect in the region. In this context, it is essential to improve the presence and dissemination of such information to help dispel doubts about the final destination of the funds.

Although the presence and promotion of development finance institutions for issuing green bonds in the RE sector has greatly improved in recent years, it is necessary to continue progressing on this point. Furthermore, investors should promote a greater commitment to training programs by companies that are already issuers, counteracting the lack of knowledge and the perceived risks regarding the costs, administrative procedures, and reputational risks that these operations entail. In this regard, green bonds are beginning to gain ground, as evidenced by the size of the largest issuances. In this context, closer cooperation and partnerships are essential to share responsibilities and knowledge in order to turn the LAC region into a RE hub supported by green bonds or other innovative instruments of the green spectrum.

Finally, our study has faced the problems resulting from the precarious disclosure of information in some of the transactions as well as the lack of granularity of the data on the funds channeled to RE. Accordingly, there is great potential for further research on green bonds to delve into RE and other specific sectors with still little explored dynamics, particularly those highly related to advances in RE, such as transport and clean buildings, as also indicated Wen et al. (2023). Also, further research could analyze the dynamics correlations between green bonds, CO₂ emissions, and oil prices using machine learning models. In this way, it is also mandatory to gain a better understanding of the perspectives of energy industry executives on green bonds and other green mechanisms as alternative funding sources that allow a better understanding

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