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# GREEN TRANSITION IN EMERGING COUNTRIES: THE ISSUANCE OF GREEN BONDS BY BRAZIL AND CHINA

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## **Abstract:**

Green bonds had emerged as a financial innovation, mobilizing incremental resources for long-term financing of projects focused on building sustainable infrastructure. Since COP-21, new ways of producing and consuming, that mitigate environmental and climate change, have been emphasized and several countries committed themselves to increase their participation in the green bond market. The aim of this article is to identify the main characteristics and differences of the green bond market in Brazil and China, especially in terms of the sectors and the allocation of income. For this, information on the amount issued in certified green bonds, in the Climate Bonds Initiative database, was used. In terms of the total amount issued in certified green bonds and the allocation of resources by sector, China shows more significant results. This shows that the financial characteristics of this country associated with planning and well-coordinated national policies have contributed to Chinese having better results.

**Keywords:** Green Bonds; Green Finance; Emerging Countries; Brazil; China

**Código JEL:** G10; G2; O16

**Área Temática:** 7. Tecnologias Sociais e Ambientais

7.3. Inovação, desenvolvimento e sustentabilidade

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## 1. INTRODUCTION

As part of the economic development process, global consumption and production patterns have been questioned from the point of view of natural capital losses and greenhouse gas emissions into the atmosphere, especially in Developed Countries (DCs). In the case of Emerging Countries (ECs), although they are responsible for lower average annual emissions compared to DCs, they have significantly increased their CO<sub>2</sub> emissions, mainly in relation to the consumption of their richest population (Gore, 2015). The observance of the economic logic that there are natural limits on a planet with finite resources is necessary when observing that the sustainability of economic development has been threatened by the indiscriminate and irrational use of nature (Vianna, *et. al.*, 2009).

From the end of the 1980s on, the concept of sustainable development gained notoriety through the Brundtland Report<sup>1</sup> published by the United Nations (UN), which can be defined as a process that guarantees the permanent expansion of individual rights in order to stimulate the maintenance and renewal of resources offered by ecosystems to the whole society (Abramovay, 2010). If there is an understanding that economic activities are established in the natural environment, it is understood that development cannot be harmful to the environment (Sachs, 2008).

Already in the mid-2010s, the process of transition from a high carbon economy to a more sustainable economy, coupled with the financing possibilities of this process, became priority issues in the countries' economic development agenda (Agliardi and Agliardi, 2019; Gianfrate and Peri, 2019; Vianna, *et. al.*, 2009). The 21st Conference of the Parties (COP-21) highlighted the need to think about new ways of production and consumption, taking into account social and environmental factors (Caré, *et. al.*, 2018). On this occasion, the countries committed themselves, through the signature of the Paris Agreement, to limit the global temperature increase to 1.5 to 2°C below pre-industrial levels by the year 2030, which is only possible with the reduction of carbon dioxide (CO<sub>2</sub>) emissions into the atmosphere. For the intended change to occur, a profound transformation in energy production, industry, construction, land use, transportation, among other factors, is essential (Gianfrate and Peri, 2019; OECD, 2017).

Given the demands inherent in the transition to a low carbon economy, one of the possible alternatives for countries is the adoption of strategies aligned with innovation, which is essential for the transition to a low carbon economy and capable of incorporating both social and environmental pressures<sup>2</sup>, considering the impacts for future generations (Hall and Vredenburg, 2003; Carney, 2015). Innovation aimed at sustainable development is complex, given that new production processes must be incorporated and presents greater risk due to the uncertainties inherent in novelty and therefore requires greater financial investment (Hall and Vredenburg, 2003; Kemp and Never, 2017). In this sense, the financial system has a crucial role to assist and mobilize investments for the adoption of clean technologies and energies for the decarbonization process of the economy. It is estimated that this transition will demand a global change in the infrastructure and industry systems that require a massive investment of approximately \$447 trillion between 2016 and 2050, which is \$12 trillion more than is needed for business as usual (Gianfrate and Peri, 2019; Chenet, *et. al.*, 2017).

Thus, the green bonds are an important financial innovation for countries to meet their climate commitments, taking into account the new patterns of production and consumption, by financing projects aligned with sustainable issues (Agliardi and Agliardi, 2018; Banga, 2018). However, work on the green bond market is still scarce, especially regarding the willingness of public or private institutions to finance themselves from the issuance of these bonds. When opting for this type of financial instrument, it is necessary to define the sector in which the income will be employed, according to a defined taxonomy.

Within the DCs, there are already programs, guidelines and actions that are better coordinated to meet the objectives of COP-21<sup>3</sup>. However, on the part of the ECs, there is still more heterogeneity in the alignment of countries to common goals, as well as a greater gap in the work proposed to this type of

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<sup>1</sup> See UN (1987).

<sup>2</sup> As stated by Markkanen and Anger-Kraavi (2019), the discussion on mitigating climate change needs to incorporate issues such as inequality, especially for minority and most vulnerable groups. The large-scale transition to a low-carbon economy that will influence economic and health inequalities, social cohesion and wellbeing.

<sup>3</sup> According to ECB (2018): “the market for green bonds has developed rapidly in recent years, with global issuance rising from less than €1 billion in 2008 to more than €120 billion in 2017. Euro-denominated net green bond issuance has increased. During the period 2013-2018, total net euro-denominated green investment grade issuance in the euro area represented around 24% of global net green issuance. (...) Green bonds generally offer similar yields to comparable conventional bonds, but there is evidence that in some market segments issuers can borrow at lower rates than via conventional bonds, which is consistent with the interpretation that investors are prepared to forgo some income as a result of their self-imposed investment constraints”.

analysis for these countries. To address the gap in studies on the green bonds market in EC's, this article aims to make a comparative effort between two of them: Brazil and China. The general objective is to answer the following questions: Are there significant differences between Brazil and China in relation to the characteristics of their green bond markets? What are the sectors where the largest allocation of income from green bonds is concentrated in these countries?

The justification for the choice of the two countries is due to the importance of the green financing theme for discussions involving the green transition, but also, as mentioned that the literature on green finance is relatively recent and there are still few papers aimed at understanding the characteristics and performance for developing countries. Finally, this article is divided into four sections, in addition to this introduction. Section 1 will present the overview and attributions of the global green bond market, putting into perspective the challenges this market still has to overcome. Section 2 will present a brief characterization of the green bond markets in Brazil and China. Section 3 will present the methodology and provide the main results and discussion. Conclusions are presented in Section 4.

## **2. OVERVIEW AND ASSIGNMENTS OF THE GREEN BOND MARKET IN THE TRANSITION TO A LOW CARBON ECONOMY**

Until the late 1990s, the financial sector did not emphasize climate change as an important topic to consider in its activities. It was from the year 2000 that the first financial institutions started to incorporate this theme, but in a limited way, restricting themselves to the carbon market and the financial activity of the projects, being considered only the project risk for the environment, but not the environment risk for the project. The tools for associating the effects of climate with finance were only boosted with the holding of COP 21 in 2015, with the signing of the Paris Agreement, through which the countries committed themselves to making the transition to a low carbon economy and for this they redirected a massive financial flow to achieve their climate objectives (Chenet, 2019).

Just over a decade ago, green bonds emerged with the objective of mobilizing incremental resources for long-term financing of projects aimed at building sustainable infrastructure aligned with public commitment to climate objectives, through the adoption of new technologies and new production patterns in order to reduce the carbon footprint of countries (Bachelet, *et. al.*, 2019; Ketterer, *et. al.*, 2019). This class of bonds has the characteristics of fixed income<sup>4</sup> securities and the fact that their emitters must declare the projects to be financed (Fender, 2019). Although there is no common standard for defining what green bonds are, the *International Capital Market Association* (ICMA) has developed a guideline entitled *Green Bond Principles* (GBP) that defines this class of bonds as “[...] any type of bond instrument<sup>5</sup> where the proceeds will be exclusively applied to finance or re-finance, in part or in full, new and/or existing eligible green projects [...]” (ICMA, 2018, n. p.).

Supranational institutions have played an important role in encouraging the financial community to broaden the scale of this market and highlight the importance of developing country membership in relation to climate change (World Bank, 2015). In practice, the European Investment Bank was the pioneer in issuing bonds with climate objectives, having issued in 2007 an amount of EUR 600 million, for the purpose of financing projects related to energy efficiency and the use of renewable energy. The following year, the World Bank, through the International Bank for Reconstruction and Development (IBRD), issued its first green bonds in the amount of approximately US\$ 400 million (World Bank, 2015; Deschryver and Mariz, 2020; Flammer, 2020).

At the end of 2013, the Swedish company *Vasakronan* inaugurated the corporate green bond issuance, having raised EUR 145 million to finance improvements in the construction sector, information technology and financial leasing activities (Hay, 2013). Bank of America and Électricité de France also made their first issues. The following year, although the European Investment Bank was the largest issuer of green bonds (by amount issued), the largest percentage of issues came from corporate institutions rather than development banks (CBI, 2014). These institutions have been important players in the green finance market, which will be verified for the cases of Brazil and China.

In recent years, the number and amount issued in green bonds by public and private institutions have gone through a process of rapid growth, as can be seen in Table 1. In 2014, the introduction of Green

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<sup>4</sup> Fixed-income bonds are those that offer a fixed return, received at regular intervals defined by formal documents (World Bank, 2015; Neto, *et. al.*, 2019).

<sup>5</sup> It should be noted that this definition refers only to instruments classified as securities, given that there are other financial mechanisms for impact mitigation caused by climate and environmental changes. An example is the ‘Debit for Nature Swap’, which due to the growing debt of developing countries, amplified by the Covid-19 pandemic, returned to the debate (Steele e Patel, 2020).

Bond Principles by ICMA was a catalyst for the growth of this market. The GBPs require four key components for bond certification: i) indication of the sector in which the earnings will be allocated and what environmental benefits are intended to be achieved; ii) clear communication with investors; iii) management of the earnings, which means they need to be properly tracked by the issuer; and iv) availability and updating of information on the use of the funds through reports (ICMA, 2018).

Along with the GBP, another international standard for bond certification is the Climate Bond Standard (from the Climate Bonds Initiative). The certification is characterized as a process in which the bond receives the green label, which indicates that its revenues will be used to finance projects aligned with environmental or climate issues, which gives investors greater confidence, reducing the risk of greenwashing<sup>6</sup> (Deschryver and Mariz, 2020; Fender, *et. al.*, 2019).

According to the Climate Bonds Initiative (2017), from June 2015 to June 2016 the growth of this market was 92% in terms of the amount issued, surpassing what was registered in previous years. In 2019, the green bond market reached a new global record of US\$ 257.7 billion in emissions, 17% of this volume referring to certified green bonds. In the same year, the three countries that issued the most green bonds were the United States, with a total of US\$ 51.3 billion, China with US\$ 31.3 billion<sup>7</sup> and France with US\$ 30.1 billion (CBI, 2020a).

Table 1 – Amount and number of Green Bonds issued over the years

Year	Issuance of GB (\$ Bi)	Number of GB	Issuance of conventional bonds (\$ Bi)	Number of conventional bonds	Share of GB (US\$) (%)	Share of GB (Number of bonds) (%)
2018	143.1	519	32,341.70	191,362	<b>0.441</b>	<b>0.27</b>
2017	146.6	441	38,893.20	172,645	<b>0.376</b>	<b>0.255</b>
2016	95.4	263	37,268.90	146,912	<b>0.255</b>	<b>0.179</b>
2015	47.7	328	31,573.70	132,506	<b>0.151</b>	<b>0.247</b>
2014	34.5	138	29,300.90	123,106	<b>0.118</b>	<b>0.112</b>
2013	13.2	39	27,196.30	114,474	<b>0.049</b>	<b>0.034</b>
2012	2.1	21	30,066.00	100,283	<b>0.007</b>	<b>0.021</b>
2011	1.2	30	28,125.80	86,096	<b>0.004</b>	<b>0.035</b>
2010	4.4	55	28,268.90	83,112	<b>0.015</b>	<b>0.066</b>
2009	0.9	13	28,868.60	86,364	<b>0.003</b>	<b>0.015</b>
2008	0.4	7	23,686.40	115,269	<b>0.002</b>	<b>0.006</b>
2007	0.8	1	20,571.30	118,215	<b>0.004</b>	<b>0.001</b>
<b>Total</b>	<b>490.4</b>	<b>1,855</b>	<b>356,161.80</b>	<b>1,470,344</b>	<b>0.138</b>	<b>0.126</b>

Note: Flammer (2020) considered all bonds present in the Bloomberg database, except municipal bonds<sup>8</sup>. Source: Flammer (2020).

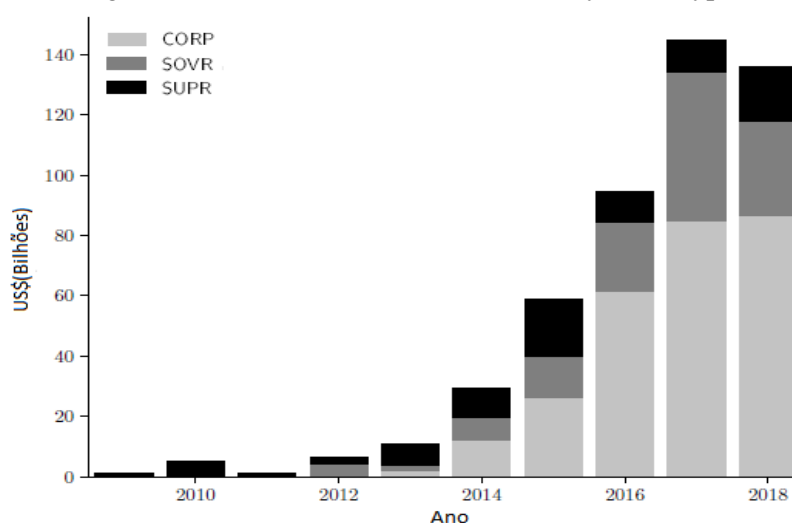
About the sectors that received the largest investments through green bonds in 2019, those of energy (wind and solar) and low carbon buildings correspond to a share of 61%. The low-carbon transport and water infrastructure sectors corresponded to a percentage of 20% and 9% respectively (Ibidem, 2020a). As for the type of emitter, from Figure 1, it can be observed that in percentage terms, corporate institutions have remained leaders in the volume emitted in green bonds since the year 2014.

<sup>6</sup> Greenwashing is a practice that involves the misleading or unfounded claim, by a company, of the benefits of its products, processes, technologies, among others, for the environment and also when there is a greater spending of time and money with green advertisements than with the effective adoption of sustainable practices (Deschryver and Mariz, 2020).

<sup>7</sup> Figures for China include only emissions in line with international definitions - Climate Bond Standards or Green Bond Principles (CBI, 2020a).

<sup>8</sup> Municipal bonds are fixed income securities issued by local governments (municipal, district and even state) that its objective is to finance projects related mainly to infrastructure (Corporate Finance Institute, 2020a).

Figure 1- Volume issued in Green Bonds by issuer type



Note: CORP: corporate institutions; SOVR: government entities and SUPR: supranationals institutions. Source: Kapraun e Scheinsz (2019).

The participation of corporate institutions in the volume issued in green bonds can be explained, among other factors, by the reputational benefits associated with this instrument. That is, for the investors, is an indicator that the issuing institutions are aligned with environmental goals. As a result, these institutions experience a diversified investor base, which facilitates the raising of new funds for sustainable initiatives. However, the transition to a low carbon economy is a costly process (in financial terms), especially for institutions belonging to economically and industrially less developed countries. Thus, polluting energies, such as coal, are still seen as a cheaper input, and therefore more advantageous for production (Markkanen and Anger-Kraavi, 2019; Wang, *et al.*, 2019; Gramkow and Anger-Kraavi, 2018).

Because of this, institutions, whether public or private, need to be encouraged, through public policies at the firm's national or international level, to finance sustainable projects from the issuance of green bonds (Barua and Chiesa, 2019). In addition to incentives on the supply side, investors also need to have the perception that the green bond market is more advantageous than regular bonds. According to Fender, *et al.* (2019), these advantages can be perceived through the comparative analysis between green bonds and their respective non green counterparts, according to three important eligibility aspects: return, liquidity and security.

The return (or profitability) of a fixed income security refers to the percentage of remuneration the investor receives, at each regular period, from the amount invested. This characteristic is related to the interest rate (coupon) determined by the issuer, as highlighted by Neto, *et al.* (2019). Liquidity, in turn, is a characteristic that refers to the instrument's ability to be traded quickly with a small impact on price, which will depend on at least two factors: the stock of instruments available for investment and the transaction cost. The stock of available instruments depends on the size (amount issued in bonds) and diversification (currencies in which the bonds are issued) of the green bonds market (Fender, *et al.*, 2019). With respect to transaction costs, these refer to the costs incurred by issuers to obtain green certification, which is summarized as the costs with second opinion agents<sup>9</sup>, the costs to produce the documents that contain the necessary information for certification, as required by international standards, and also the cost related to the follow-up of the use of the proceeds (Fender, *et al.*, 2019; Banga, 2018).

For the third eligibility criterion, which concerns the security level of green bonds, the credit risk profile is considered, which is associated with the issuers' ability to honor their financial commitments. Fender, *et al.* (2019) points out that although the safety of a security goes beyond credit risk analysis, central banks, for example, restrict their portfolios to the best rated credits. In addition, investors not only analyze the cash flows obtained through the investment, but also the full balance sheet of the issuers.

According to the World Bank (2015), from January 2014 to April 2015, of the total US\$ 51 billion issued in green bonds, US\$ 32.4 billion represented bids below AAA<sup>10</sup>, and US\$ 15 billion below BBB.

<sup>9</sup> Second opinion agents are specific institutions that evaluate and certify if the projects are in fact aligned with sustainable objectives and also provide investors with details about the projects in order to increase the reliability of the security issued (Febraban, 2015). The cost with these agents can be from US\$ 10 thousand to US\$ 100 thousand (Ketterer, *et al.*, 2019).

<sup>10</sup> Credit assessment refers to the rating given by specific credit agencies (Standard & Poor's, Moody's, Fitch Ratings

However, data for 2019 indicate that about 65% of green bonds issued had a high degree of rating, above BBB+ (Fender, *et. al.*, 2019). In addition, credit rating is one of the factors that most significantly determines the *greenium*, which is defined as the difference between the yield of conventional bonds and the yield of green bonds, both with the same characteristics (Zerbib, 2018; Agliardi and Agliardi, 2018). Works such as Bachelet, *et. al.* (2019) analyzed some of these characteristics of green bonds (the volatility, premium and liquidity) in comparison to conventional bonds in order to see if this class of bonds is more attractive to investors. According to the results found by the authors, green bonds present a higher premium<sup>11</sup>, accompanied by higher liquidity and lower volatility when compared to regular bonds. When considering the type of issuer, public or private, the authors concluded that green bonds issued by public institutions have a negative premium and are more liquid, while private bonds have a positive premium and very low liquidity, both compared to conventional bonds.

Similarly, Kapraun and Scheins (2019) compared the green bonds with the conventional bonds in both the primary and secondary markets. As a result, the authors found that in the primary market the green bonds present a negative premium, that is, when they are issued, these bonds are traded for a lower yield. In relation to the secondary market, the data showed that green bonds are traded at a higher yield for government issuers and supranational institutions. Bhandary, *et al* (2021, p. 6) stated that “*green bond policies and guidelines have contributed to increase the green bond market but whether it has actually reduced the cost of capital for climate change projects remains disputed*”. According to these authors based on different studies suggesting that green bonds can be equally or more competitive than traditional bonds while others observe a negative premium for this financial instrument.

Besides the characteristics that lead the choice of green bonds vis à vis conventional bonds, another aspect that has drawn attention is the question of the capacity of the green bonds market to gain scale (Deschryver and Mariz, 2020; Ketterer, *et. al.*, 2019). Although this market has shown significant growth in terms of the amount issued, it represented, in 2018, a share of less than 0.5% in relation to the bond market as a whole, which indicates that this market remains small if we consider the challenges it is intended to face, having made a marginal contribution to investment in green projects (Deschryver and Mariz, 2020; Ketterer, *et. al.* 2019). Some factors have been pointed out as the main barriers to the growth of this market, which are the lack of institutional arrangement for the management of green bonds, the issue of minimum size, the high transaction costs associated with it, the perception of uncertainty regarding the benefits in the issuance of bonds and greenwashing (Banga, 2018; Deschryver and Mariz, 2020)

In addition, the determinants and obstacles faced for the greater growth capacity of the green bond market and the convenience of issuing this instrument should be analyzed taking into consideration the differences in the financial arrangement of each country. It is worth noting that developing countries do not have a well-functioning bonds market, which makes it difficult to access and issue green bonds, which can be explained by the lack of a developed financial market capable of managing and monitoring projects with climate and environmental goals (Banga, 2018; Barua and Chiesa, 2019).

Therefore, the next section will briefly contextualize the Brazilian and Chinese bond markets, pointing out the main characteristics of both markets and the challenges faced by each of them in issuing green bonds. The choice for these countries, is due to the fact that both are emerging, and have the National Development Banks (NDBs) as important institutions in the green finance market. According to Bhandary *et al* (2021, p.6), NDBs can alter the behavior of other financial institutions or investors. “*These banks not only have directly provided concessional finance to firms, but can also leverage more private finance through de-risking and learning spillovers by helping new entrants build track records, or even creating markets that didn’t exist before*”.

And also, the choice is related to the fact that China is the country that issues the most green bonds in the world (considering those that are self-titled and those that are certified by international standards). In the case of Brazil, the country has drawn attention for the expansion of this market and due to its potential to become an expressive green bond market. It is also reiterated that works analyzing the impacts of this market for emerging countries are still scarce.

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and others) on an institution's ability to meet its financial commitments on time. It can also represent the credit risk of an instrument. The rating ranges from (AAA) bonds with a lower credit risk profile to those with an intermediate risk profile (AA+, AA, AA-, A, A, BBB+, BBB- and others) to those with a higher credit risk profile (D) (Corporate Finance Institute, 2020b).

<sup>11</sup>Some works like Zerbib's (2018) found a negative premium for the green titles, in relation to their conventional peers. For this author, this result is due to the fact that the impact of investors' preference for pro-climate instruments has a low impact on the yield of green bonds.

### 3. BRIEF CONTEXTUALIZATION OF THE GREEN BONDS MARKET IN BRAZIL AND CHINA

China has been configured as the largest CO<sub>2</sub> emitter both globally and per capita, while having the largest developing economy in the world. Although its economic growth has been driven by the use of low-cost polluting energies such as coal, on the other hand, the country pays for high environmental costs associated with its development pattern (Gore, 2015; Wang, *et. al.*, 2020). In 2014, the Chinese government promised to reduce its carbon emission (emission/GDP) by 60% compared to 2005 levels by the year 2030, and reported that it had raised the issue of green finance development to the level of a national strategy (Schipke, *et. al.*, 2019; Wang, *et. al.*, 2020).

In its Twelfth Five-Year Plan (FYP), which ran from 2011 to 2015, the country had ambitious plans to increase the number of industries aligned with environmental issues and reduce the environmental stresses caused by its development model, requiring a major mobilization of capital (Kidney, *et. al.*, 2014). Thus, to maintain more sustainable economic growth, China has improved the efficiency of government investments, attracting the largest number of private investments, and for this it needed changes in the arrangement of the financial system to meet climate objectives (Ibidem, 2014).

In this scenario, China made its first green bond issuance in 2016 through its development bank, the Shanghai Pudong Development Bank, and has since then been established as the largest green bond market in the world, in terms of the volume of certified and self-certified bonds issued (Wang, *et. al.*, 2019; CBI, 2019; CBI, 2020b). It is important to note that China has its own guideline on bonds classification and certification, different from most countries that follow the ICMA Green Bond Principles and the CBI Climate Bond Standards. This guideline included the clean use of coal as one of the categories for title certification, which could limit investments due to the fact that for some investors the financing of this sector is unacceptable (Deschryver and Mariz, 2020).

In 2020, in order to attract international foreign investment, the People's Bank of China, the Central Bank of China, the China Securities and Regulatory Commission and the National Development and Reform Commission announced the exclusion of fossil fuels from their taxonomy (CBI, 2020c). In addition, this same year, China's president, Xi Jinping, declared that by the year 2060, the country intends to achieve carbon neutrality (zero emission) through the adoption of more robust public policies (Machado, 2020; Stern and Xie, 2020). Through its fourteenth five-year plan (2021 - 2025), the Chinese government emphasized the need for the country to adopt a new development path, based on resilience and sustainability and, for this to happen, it is essential that investments are made in low carbon technologies (Stern and Xi, 2020).

Besides China, another green bond market that has been the target of attention, due to its growth potential, is the Brazilian's. The first issuance of this instrument in Brazil was made in 2015 by BRF S/A, a food company, which raised EUR 500 million in the international market. The following year, Suzano Papel e Celulose S/A made its first issue of green bonds in the domestic market, worth R\$ 1 billion. Since then, Brazil has issued more than US\$ 5 billion in green bonds and this number is expected to grow considerably, mainly for agribusiness financing (Borges, 2019).

From the first emissions made in this market, it is possible to infer one of the significant differences between both countries: while in China the first emissions were made via development banks, in Brazil, it was made by Brazilian companies belonging to the so-called "new market" of the Brazilian Stock Exchange (B3) linked to the polluting sectors (BRF: agribusiness; Suzano the largest pulp and paper company in the world). As both trade their shares in the Brazilian stock market - it is inferred to be more prone to financialization for speculative purposes. The main characteristics of this process will be discussed in the results.

Although expectations for green bonds market growth in Brazil are positive, Borges (2019) states that this market has not grown as it should, due to the fact that investors are still turning to short term investments. Therefore, the green bonds market needs to overcome some challenges and, for such, it is necessary to take into account the economic situation. Even though the Brazilian capital market has a higher demand for fixed-income bonds, it still faces the impacts of the long period of instability and inflation experienced by the country, which makes it difficult to develop activities based on long-term returns (FEBRABAN, 2015; Wolf, *et. al.*, 2017).

In this sense, FEBRABAN (2015) points out some obstacles that have limited the growth of this market in Brazil, being i) the additional cost to place green bonds in the market; ii) lack of incentive for the underwriter<sup>12</sup> to structure a green bond instead of a conventional one and iii) the perception of greater

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<sup>12</sup> Underwriters are institutions chosen by issuers to act as the leading coordinator of the bonds issue operation, being responsible for developing the structure (characteristics of the bonds, such as maturity and payment coupon), price



risk by investors in relation to the financing of new technologies. Converging with the notes made by FEBRABAN (2015), the Brazilian Development Association (2018), through the application of questionnaires targeted at potential issuers and investors in the green bond market, detected that, in addition to the obstacles pointed out by Febraban (2015), issuers would be less likely to be financed through this instrument, due to the fact that the secondary market is still incipient (as also pointed out by Fender, *et. al.*, 2019), the need for technical support, among other factors. On the investors' side, ABDE (2018) reached the result that the barriers are related to the lack of promotion of security liquidity, through the secondary market, the lack of offer for the segment in which the investor operates, the lack of specific regulatory incentives, etc.

With this, FEBRABAN (2015) proposes some ways to boost the development of the green bonds market in Brazil. The first would be the creation of uniform guidelines for the framing of green bonds, that is, if the bonds of the issuing company are aligned with the guidelines, the issuance process could become less bureaucratic and thus faster. Second, the development of local second opinion agents; followed by an improvement in investors' perception of risk, through guarantees.

Next section aims to present the methodology for the analysis of the certified green bonds market, for Brazil and China, both from the point of view of the volume issued in green bonds by the two countries, as well as the allocation of revenues by eligible sectors. Other characteristics will be presented below to establish comparisons between the two markets.

## **4. EMPIRICAL DESIGN AND RESULTS**

This work aims to investigate the eligible sectors that receive the highest percentage of income allocation obtained through the issuance of green bonds and, from this, we intend to highlight the different characteristics of the countries' green bond market in relation to the projects that have been financed, both in Brazil and in China. For this purpose, despite the scarcity of data, information on the amount issued in green bonds certified by the Climate Bond Standard, which are available in the Climate Bonds Initiative (CBI) open database, will be used. The choice to analyze only certified bonds is due to the fact that they provide greater security to investors and have characteristics, such as premium, liquidity and volatility, more advantageous than non-certified and conventional bonds.

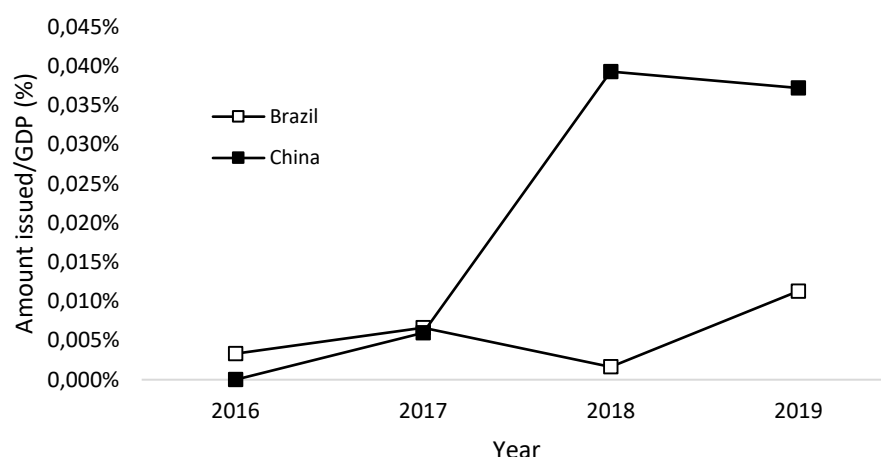
The data includes 245 records from October 2014 to March 2020, but for this analysis will be considered only the years 2016 to 2019, due to the fact that in this period, the countries - Brazil and China - made their first emissions of green bonds. It is worth noting that the Climate Bonds Initiative classifies as green only those bonds that have at least 95% of their assets allocated to activities in line with the objectives of sustainable development, according to the Taxonomy of Climate Bonds. This institution considers eight activities that can receive income from these bonds, which are related to energy (solar and wind), low carbon buildings, water infrastructure, low carbon transport, recycling and waste disposal, land use, industry and information and communication technology (ICT).

For the comparative analysis of the amount issued for each of the sectors, the Gross Domestic Product of each of them was used like the 'size of the economy', referring to the years 2016, 2017, 2018 and 2019, at current US\$. The data were obtained through the World Bank database. The following are the results that allow one to glimpse the possible explanations for the greater allocation of income in each of the eligible sectors.

### **4.1- RESULTS AND DISCUSSION**

As noted in Section 3, the characteristics and developments of the green bond market in Brazil and China presents some challenges that still need to be overcome in order to make this instrument more attractive to possible issuers and investors and, consequently, enable the growth of this market in scale. Corroborating the literature that points China as one of the largest green bond markets in the world (CBI, 2020a; CBI, 2020b; Flammer, 2020), the result, presented through Graph 1, points to a significant growth of the Chinese green bond market, in relation to the amount issued in certified green bonds, considering the country's GDP.





Graph 1 - Amount issued in certified Green Bonds – Brazil and China

Besides the fact that China managed to raise the climate objectives to a national policy level (Schipke, *et. al.*, 2019; Machado, 2020), it is inferred that the growth of the green bonds market was made possible because in this country the financial market gradually began to be considered one of the bases for economic development, especially from the period after the 2007 financial crisis (Petry, 2020). In this sense, differently from other countries, such as Brazil, where the financialization process<sup>13</sup> is placed as a result of neoliberalism and, consequently, causing a decrease in the role of the State (Lavinias, *et. al.*, 2017), in China the use of financial instruments to achieve economic policy objectives has strengthened the influence of the State in the Chinese economy (Pan, *et. al.*, 2020; Petry, 2020).

Pan, *et. al.* (2020) justify as the main institutional factors to understand this process in China: the reform (and opening) of its financial system together with a strong State action (either in providing financing - especially via development banks - or in supervision and monitoring). The State has a strong participation in the process of economic development and has promoted a "regulated" reform of its financial system (through the deregulation of financial markets) and economic - which has as a consequence the increase of financial instruments available for development financing. The second important point is that in China the financial system is largely controlled by the state, as are most financial institutions (banks, brokerage houses and insurance companies).

This role of the State in economic development has been different in Brazil. According to Teixeira and Pinto (2012), the State lost its prominence as a developer when the import substitution model was exhausted in the late 1980s, also the result of the fiscal crisis that facilitated the adoption of neoliberal model in Brazil. For Bruno and Caffé (2017, p.1031), the Brazilian State acted under strong pressure from neoliberal policies, with the support of the political class, especially for structural reforms that produced greater macroeconomic instability, accentuated a stop-and-go growth pattern, increased the economy's external vulnerability to international financial market shocks (to which high interest rates were used to attract foreign capital or to discourage capital flight), and exploded external and especially internal public debt. In addition, according to these authors, austerity policies generated a decrease in public spending and investment. As a result, the economy's gross capital formation fell sharply.

When analyzing the Brazilian State in face of the structural transformations (internal and external) of the 1990s, authors such as Teixeira and Pinto (2012); Bruno and Caffé (2017), reflect that as a regulatory and organizing instance of capitalist development in a particular way, the State seeks to meet the interests of certain social classes and/or economic sectors, which manifest their hegemony through particular forms of legitimization. Furthermore, according to these authors, it acts as an articulating instance of the national economic and territorial space with the world capitalist system. Thus, in an economy like Brazil's, whose hegemony belongs to the financial sector, the State becomes an institutional instance organizing the economic spaces necessary for the development of wealth accumulation, giving priority to the interests of high finance, even at the expense of social needs and national development.

Teixeira and Pinto (2012) point out that the situation of dependence (and subordination) involves the articulation between the economic and political system and between domestic and foreign social classes and groups. Thus, banking and financial capital (banks, insurance companies, pension funds, brokerage

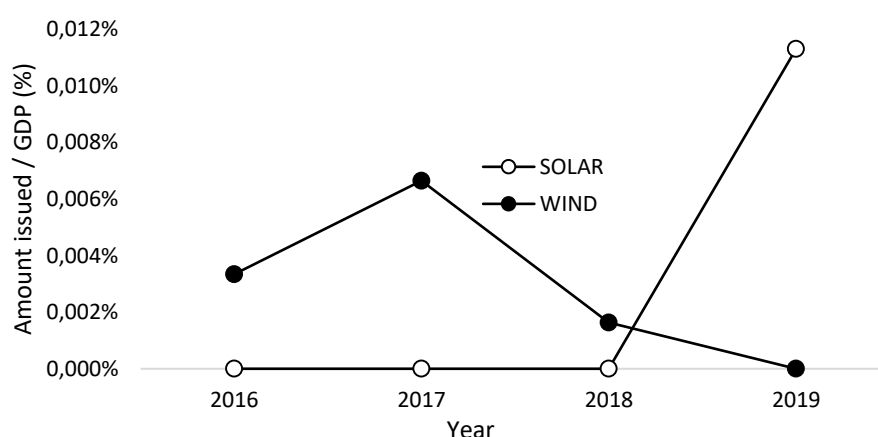
<sup>13</sup> Epstein (2005) defines financialization as a process where there is an increase in the role of motivations, markets, financial actors and institutions in the operation of both national and international economies.

houses, rating agencies, etc.) begins to hold hegemony within the ruling block and its influence, expressed especially from one of the main centers of power in the state: the Central Bank, whose influence is exercised since the propagation of the ideology of economic orthodoxy, as directly, by the exchange of positions between directors and presidents of the Central Bank and occupying key positions in the financial market (Ibidem, p. 917).

Along these lines, Bresser-Pereira, *et. al.* (2019) point out that the prevalence of high real interest rates in Brazil for decades led to the formation of a coalition of interests of rentier-financiers in maintaining high interest rates, since these favor the valuation of their financial wealth ("financialization through interest gains"). This would justify that, by the end of 2018, even with the recent sharp reduction in real interest rates, in a context of acute and prolonged recession and high unemployment, Brazil still has one of the highest real interest rates in the world, revealing the pro-conservative convention of monetary policy in Brazil.

These characteristics of the Brazilian financialization process and the changes in the role of the State help to understand the lethargy in the development of the green bonds market in Brazil vis à vis China. Comparatively, from the results found for Brazil, it is understood that the growth of the certified green bonds market (in terms of the amount issued) was quite limited, if compared to China. From this, it is clear that the fixed income market in Brazil, especially the green bonds market, needs greater regulation and dynamism (Wolf, *et. al.*, 2017) in order to make instruments with long-term yields more attractive to investors, articulated with economic policies that, as in China, raise the climate issue as a national goal. It also emerges that the history of high real interest rates prevailing in the Brazilian economy makes other types of financial instruments (including SELIC-indexed public bonds) more attractive for short-term gains, which could also be considered a barrier to the development of this market in Brazil.

Moreover, according to what was proposed for this work, another important analysis that improves the understanding of the green bonds market in both Brazil and China, is the analysis of the allocation of income obtained through certified green bonds in each of the sectors, in order to glimpse the percentage of funding allocated to each of them. The sectors considered for this analysis are in agreement with what was defined by the Climate Bonds Initiative as sectors eligible for funding through this instrument, which are low carbon transport (LCT), energy (solar and wind), low carbon buildings -residential or industrial- (LCC) and water infrastructure. The sectors of recycling and disposal of waste, land use, industry and information and communication technology (ICT), in the period from 2016 to 2016, were not financed through the issuance of certified green bonds. For this purpose, the size of the economies was also considered, having as measure the nominal annual GDP of each country.



Graph 2- Amount issued in Green Bonds by eligible sectors (% GDP) – Brazil. Note: Low Carbon Transport (LCT), Low Carbon Buildings (LCB) and Water Infrastructure sectors did not receive investment, then this information is not present in the graph.

In Brazil, most of the resources obtained through the issuance of certified green bonds were allocated to the energy sector, which includes both solar and wind energy. This picture can be explained by the fact that the National Bank for Economic and Social Development issued, in 2017, US\$ 1 billion in green bonds that were exclusively intended to finance this sector (BNDES, 2018). In practice, after deducting expenses related to the issuance of these bonds in the market, net resources allocated to the energy sector in recent years were approximately R\$ 3.2 billion, which were totally allocated to eight wind

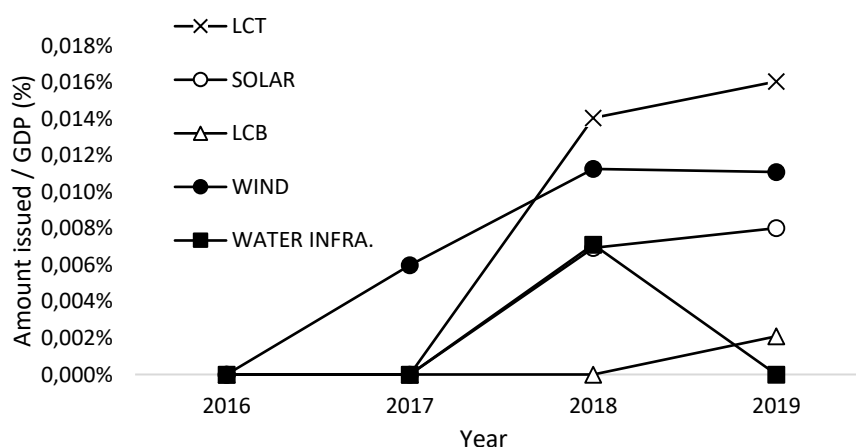
power generation projects (Ibidem, 2018). From these results, the importance of development banks to stimulate the financing of projects aligned with the climate objectives should be highlighted (World Bank, 2015).

As pointed out by the work of Ketterer, *et. al.* (2019) and other authors who have been concerned with the issue of the complementary participation of the private sector in green financing and in the transition to a more sustainable economy, the significant increase in financing in the solar energy sector in the year 2019 can be explained by the fact that in the same year AES Tietê made the first issue of certified green bonds, in the amount of R\$ 820 million, in order to finance the largest solar energy projects in the state of São Paulo, which are the Guaimbê and Ouroeste plants (Coimbra, 2019).

Although in Brazil there has been funding from the energy sectors (wind and solar), there has been no diversification of the sectors where the resources have been allocated, suggesting that there is a low articulation in terms of economic policies capable of boosting funding from other sectors (low carbon transportation, low carbon construction and water infrastructure) (CBI, 2018). Moreover, about half of the CO<sub>2</sub> emissions in the country are a result of the activities of the agriculture and land use sectors (CBI, 2018), which until then were not financed through certified green bonds. According to the Climate Bonds Initiative (2018), financing for sustainable growth, despite being available, is underused, one of the reasons being the low knowledge of financial institutions regarding the eligibility criteria of assets and instruments that are available.

Under study for Brazil, Gramkow and Anger-Kraavi (2018) tried to identify some fiscal instruments that would be collaborating with green innovation from 2001 to 2008. The focus was on two indirect taxes (i.e. taxes on goods and services): the ICMS (*imposto sobre circulação de mercadorias e serviços*) and the levy on manufactured products (*imposto sobre produtos industrializados*- IPI). The authors stated that despite Brazilian government introducing some short-term measures directing fiscal policy in favour of “green fiscal policy” it is necessary to improve the incentives, the policy coordination and effectiveness of these measures by implementing foreseeable, longer-term incentives for green technologies. “While subnational taxes seem to be a more viable path for it in the short-term, federal level fiscal measures should be implemented as part of a longer-term (Ibidem, p. 9). In this sense, the authors emphasize the importance to improve fiscal incentives that support innovation (such as tax exemptions and deductions for businesses that perform R&D, subsidized public finance for innovation projects led by businesses), for innovation projects in partnership with universities and research institutes and for capital goods, taking advantages of a legal apparatus to organizational and institutional capabilities already existing in favour of green innovation.

In the case of China, as can be seen from Graph 3, the higher income allocation in the transport sector can be explained by at least three factors. The first is that this sector is one of the main sources of carbon gas emissions and the one that consumes the most energy in the country, and the second is that China Railway Corporation, a state-owned company that is one of the largest builders of new railroad infrastructure in the world, has been one of the largest emitters of green bonds globally. In addition, this sector is led by the government, which has increasingly seen the need to urgently establish a low-carbon energy transport system (Huang, *et. al.*, 2016, Stern and Xi, 2020). The third aspect that may explain the greater allocation of resources in the low-carbon transport sector is that there is a large number of railroad sector emitters who already have a track record of issuing conventional bonds (CBI, 2014).



Graph 3- Amount issued in Green Bonds by eligible sectors (% GDP) – China. Note: LCT: Low Carbon Transport and LCB: Low Carbon Buildings. Source: Authors’ elaboration based on data from Climate Bonds Initiative (2020d) and World Bank (2020).

As for the renewable energy sectors (solar and wind), China was the country that most attracted investments in this sector in 2018, at a percentage of 33% compared to what was financed worldwide (IRENA, 2020). According to the Annual Report of the Global Wind Energy Council, the country is the largest market for wind power generation in the world, having connected 23.8 gigawatts (GW) to the grid onshore, totaling 230 GW in capacity in the country. It should be noted that the government has offered conditions, through national policies, so that the renewable energy sector, especially wind, can be financed through the financial system, which ends up having an impact on the amount issued in certified green bonds.

Respect to solar energy, this country produced more than 60% of the solar panels in 2018, and in the following year the largest world producers were Chinese (Machado, 2020). It is worth noting that the sectors of renewable energy and low carbon transportation are those that have received the most attention in Chinese development policies, which have taken into account the technological bottlenecks and market structures of these sectors (IRENA, 2020).

Comparing policy design and implementation of climate finance policy in different countries, Bhandary, *et al* (2021, p.3) highlight that stability, simplicity, transparency, consistency, coordination, and adaptability as the key features for the effectiveness of policies to stimulate green financial flows. According to the authors, in terms of instruments and definition policy, China has stood out with developed countries like the US and Germany, for example. They identified that China has encouraged the following instruments: target lending, green bonds, Feed-in-tariffs (FiT)<sup>14</sup> and strengthening of National Development Banks. At the time, Brazil was only mentioned in the item National climate funds to mobilize and provide access to channel climate finance, followed by Ethiopia, Bangladesh and Indonesia.

Therefore, in view of the results found, it is inferred that there is a greater diversification of the sectors financed in China, based on the allocation of income obtained through the issuance of certified green bonds, from 2016 to 2019, than in Brazil. This fact has a strong relation with the development policies adopted by the countries, which, in the case of China, seek to privilege some key sectors for the green transition. In addition, China presents a higher result than Brazil, considering the size of the economies, in the amount issued in certified green bonds, which can be explained by the process of financialization that has been adopted by the country, in which the power of the state is amplified in order to guarantee the development of the country. In Brazil's case, the modest growth of the green bond market is an indicator of the need for economic policies to be coordinated with planning and industrial policy in order to guarantee greater investment in high carbon emission sectors.

## 5. CONCLUSION

The economic development model adopted by countries, especially developed ones, has been questioned from the point of view of the loss of natural capital and the emission of greenhouse gases into the atmosphere. Until then, economic logic has prevailed over concern with natural limits on a planet with finite resources. Faced with this scenario, other challenges accumulate in the green transition process, such as planning, the creation of instruments, incentives, innovations; the demand and supply of financing (and the high financial costs involved in the transition and in mitigating climate impacts), uncertainty in several aspects.

A little over a decade ago, the green bonds emerged as a financial innovation in order to help and mobilize investments for the adoption of clean technologies and energies for the decarbonization process of the economy. In recent years, although the green bond market has experienced significant growth in terms of amount issued, this market remains small if the objectives it aims to achieve are analyzed - especially in the ECs.

Therefore, this work aimed to analyze the amount issued in green bonds in each of these countries, in a comparative manner, in the period from 2015 to 2019. It was also analyzed the allocation of income obtained through this instrument by eligible sector, defined by the Climate Bonds Initiative, based on certified bonds (considered safer and more advantageous because of their characteristics, such as premium, liquidity and lower volatility) vis à vis non-certified green bonds and the others (conventional).

As a result, it was identified that in China the highest percentage of allocation of resources from the issuance of green bonds has been allocated to the low carbon transport and renewable energy sectors

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<sup>14</sup> According to Bhandary et al (2021), FiT provides either a fixed total electricity price per kWh or a fixed premium on top of the wholesale rates of electricity for fixed periods for low-carbon electricity providers.

(solar and wind), while in Brazil the largest allocation is made only to the renewable energy sector. As noted in this study, China has expanded policies, instruments and incentives for the green transition.

In general, even though the growth of the green bonds market in Brazil and China has been identified, some of the main barriers pointed out for the growth of this market globally have also been registered, which are the lack of institutional arrangement for the management of green bonds, the issue of minimum size, the high transaction costs associated, the perception of uncertainty regarding the benefits in the issuance of bonds and greenwashing. In addition, the scale of operation required, the still incipient liquidity, the regulatory and financial institutional arrangement (banks and capital markets) of each country and especially the characteristics of the financialization process in Brazil are obstacles that make it difficult to finance the green transition. In terms of the future research agenda, it is important to incorporate a more in-depth study of these processes, as also instruments, programs, goals and results that have been achieved in each country.

From this article, it can be concluded that China performed better in terms of development and potential of green bonds than Brazil, considering the size of the economies, both in the amount issued in certified green bonds and in the allocation of resources by sector - due to its greater diversification in their financing. In addition, together with what was discussed about the green bond markets in the two countries, it is inferred that the efforts of development planning and coordination of national policies (economic, institutional, industrial), have been more effective in China.

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## TRANSIÇÃO VERDE EM PAÍSES EMERGENTES: A EMISSÃO DE LIMITES VERDES PELO BRASIL E DA CHINA, traduzido do Inglês da primeira página do artigo.

### Resumo:

Os títulos verdes surgiram como uma inovação financeira, mobilizando recursos incrementais para o financiamento a longo prazo de projetos focados em infraestrutura sustentável. Desde a COP-21, novas maneiras de se produzir e consumir, que mitiguem as mudanças ambientais e climáticas, têm sido enfatizadas e com isso vários países se comprometeram a aumentar sua participação no mercado de títulos verdes. O objetivo deste artigo é identificar as principais características e diferenças deste mercado no Brasil e na China, principalmente quanto aos setores em que os rendimentos são alocados. Para isso, foram utilizadas as informações sobre o montante emitido em títulos verdes certificados, da *Climate Bonds Initiative*. A China apresentou resultados mais expressivos quanto ao montante total emitido em títulos verdes certificados e à alocação setorial dos recursos. As características financeiras desse país associadas ao planejamento e às políticas nacionais bem coordenadas, têm contribuído para que os chineses tenham melhores resultados.

Traduzido de "Resumo" da primeira página do artigo.

**Palavras-chave:** Títulos Verdes; Finanças Verdes; Países Emergentes; Brasil; China.

Traduzido de "Keywords" da primeira página do artigo.

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