

# Green Bonds: Balancing Environmental Responsibility and Financial Objectives

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# Chapter 1

## Introduction to Green Bonds

As the global economy continues to expand, environmental challenges have become increasingly prevalent in today's world, more so than ever before. In recent years, the concern for social and environmental problems has grown and Environmental, Social, and Governance (ESG) policies are incorporated in the businesses' long-term policies. In fact, through the Paris Agreement, the United Nations calls for maintaining the temperature by incorporating these types of strategies into the businesses' long-run planning<sup>44</sup>. Consequently, businesses are demanded to adjust their practices and transition towards more environmentally sustainable projects. The International Energy Agency (IEA) estimates that around US\$55 trillion will be needed by 2035 to fund projects aimed at addressing climate change, to limit the temperature increase to a maximum of 2°C. The central problem encountered by countries is the financing of those climate-friendly projects<sup>5</sup>.

Green bonds are one of the key financial instruments used to provide capital to fund green projects and assist in sustainable development for the future. According to Green Bond Principles<sup>2</sup>, a green bond is "Any bond instrument where the proceeds will be exclusively applied to finance or refinance, in part or in full, new and /or existing eligible green projects". The expression "green bond" generally denotes a fixed-income asset class that shares similarities in financial structure with conventional corporate and government bonds (such as pricing mechanisms, ratings, etc.), but differs through the allocation of proceeds by the issuer to projects with environmental benefits<sup>13</sup>.

Green bonds are becoming a well-established sustainable investment instrument, gaining increasing popularity, not only among environmentally-conscious investors but also among investors realizing the potentially significant impact of climate change on government policies and climate-related risk for companies<sup>38</sup>.

Alongside green bonds, "sustainability" bonds and "social" bonds have also emerged, which share a similar socially responsible mandate but focus on different areas such as food security, affordable housing, and access to essential services for specific population groups<sup>34</sup>.

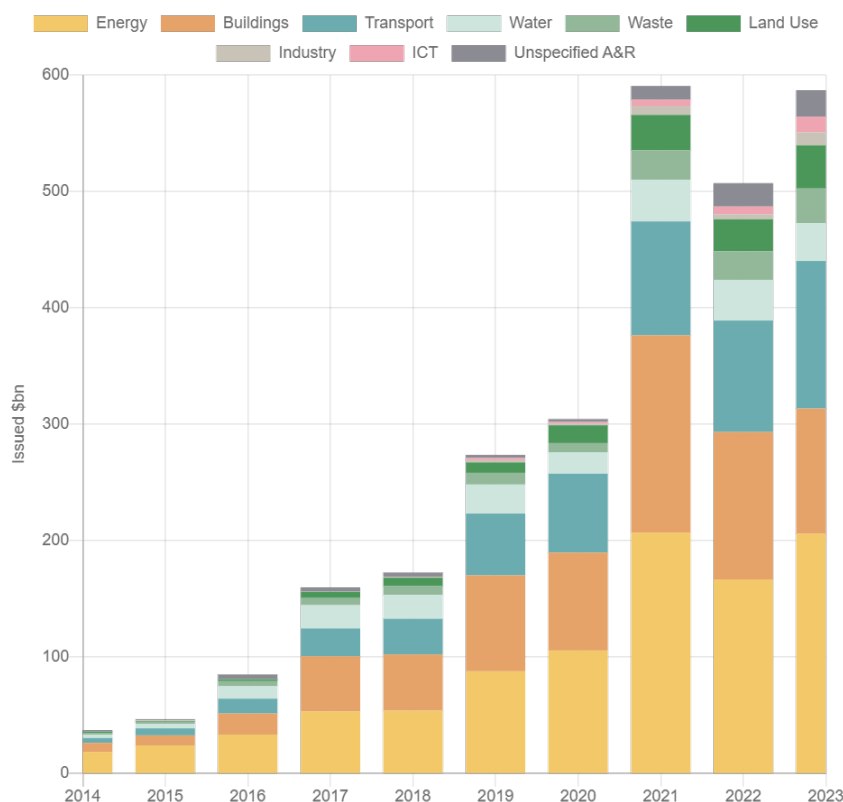
The green bond market segment currently remains modest in comparison to traditional bonds, however, there exists significant potential for market expansion as climate issues ascend higher on the policy agenda. Indeed, demand for green bonds consistently exceeds supply, and the market's infrastructure continues to mature.

The market for green bonds, as measured by the volume of green bonds outstanding, has now risen above US\$ 3.069 trillion since their first issuance, comprising 27 074 deals in 53 currencies from 2 737 issuers. Every year the rate of growth hits a new record; in fact, by the end of 2022, the cumulative size of the market was lower, amounting to US\$ 2.2 trillion<sup>6</sup> and in 2023 aligned annual volume reached US\$ 587.6 billion, breaking through the half-trillion mark for the third consecutive year, and demonstrating an increase of

15% YOY (Year over Year)<sup>36</sup>. The market’s rapid growth highlights the importance of green bond financing, requiring policymakers and regulators to understand its impact on market participants, issuers, stakeholders, and its wider implications for the economy and the environment<sup>7</sup>.

Despite this rapid growth, green bonds still represent less than 9% of the bond market<sup>22</sup>. According to the Climate Bond Initiative, as shown in the graph 1.1, at the end of 2023 green bonds are mainly oriented to the funding of renewable energy (34% of the issuance), buildings (25%), transport projects (18%).

Figure 1.1: Green bond use of proceeds categories

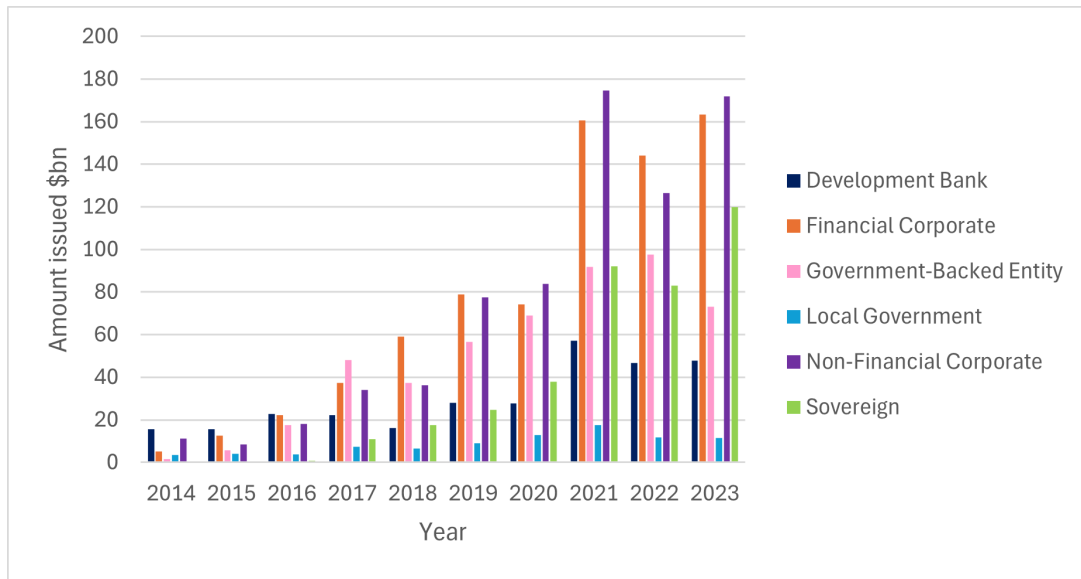


Source: The Climate Bonds Initiative Interactive Data Platform

Moreover, green bonds are issued by the private sector as corporate entities, the public sector as a sovereign government, municipalities and agencies, such as government-sponsored enterprises, and supranational entities (e.g., the World Bank, European Investment Bank, etc.). The following graph 1.2 highlights the predominant role of corporate entities in green bond issuance, which in 2023 have contributed 57% of issuance (29% non-financial corporate and 28% financial corporate).

Lastly, in 2023 green bonds are issued mainly in USD and EUR currencies. Hard currencies were the source of 80% of green bond issuance, with the EUR maintaining its position at the top for the sixth consecutive year (dominating the market with 44% of aligned volume). Europe stands out as the region with the most advanced policy measures and the largest number of dedicated investment mandates, consequently dominating green issuance.

Figure 1.2: Green bonds issuers in EU, 2014-2022



Source: 8th Environment Action Programme, 2023, European Environment Agency

## 1.1 Green bond market evolution

The world's first green bond was issued in 2007 by the European Investment Bank (EIB) as Climate Awareness Bonds and the Luxembourg Stock Exchange (LGX) was chosen as its primary listing exchange, which, to date, remains the top green bond listing venue<sup>7</sup>. Less than a year after this introduction, in November 2008, also the World Bank issued its first green bond. These bonds were followed by a small but growing stream of issues from government-related entities and local authorities, but it took several years for issuance to pick up.

By the end of 2013, less than €10 billion of green bonds had been brought, in fact, it was not until 2014 that issuance really started to increase, thanks to three significant accomplishments. Primarily, the International Finance Corporation initiated the first billion-dollar offering, which quickly reached full subscription within the initial hour of issuance. Consequently, a rapid expansion from \$US 3.1 billion to \$US 36.6 billion within two years in the market fuelled the demand for performance data on green bonds, leading to the launch of the first green bond indices in 2014 by Solactive. Additionally, in the same year were formally introduced the ICMA Green Bond Principles (GBPs), which aimed to establish transparent standards for both investors and issuers. Their introduction catalysed market development and quickly became the foundation for other green labels and indices<sup>31</sup>.

Another major turning point was the adoption of the 2015 Paris Agreement, which witnessed a remarkable declaration of investor intention. Twenty-seven global investors, managing a total investment capital of \$US 11.2 trillion, issued the Paris Green Bonds Statement, which called on<sup>8</sup>:

- Industry experts and stakeholders: to develop clear standards for the climate change impacts and benefits of bond-financed projects;
- Bond Issuers: to ensure transparency around the use of bond proceeds and their impact;

- Governments: to develop projects that can be financed by green and climate bonds.

Spanning from 2015 to 2017, the quantity of new issues doubled, and the market diversified in terms of countries, issuers, and the use of proceeds. This growth was mainly driven by a significant increase in Chinese borrowing, with \$US 36 billion worth of new green bonds issued in 2016.

Poland ended 2016 by issuing the world's first sovereign green bond, followed in 2017 by France and sovereign issues from Fiji and Nigeria represented the growing participation of emerging economies. The green label also started to find its way into Islamic finance products. Whereas US issuers entered in 2017 with significant issuance by US municipalities (mainly to finance local transportation and water projects) and by the public agency Fannie Mae through mortgages to finance sustainable housing<sup>16</sup>

In 2018, debt markets faced challenges, with the Bloomberg Barclays Global Aggregate Bond Index reducing by 1%. Despite this, green bonds showed outstanding resilience in volatile conditions<sup>31</sup>. Moreover, in 2018 International Finance Corporation (IFC) and Amundi, Europe's largest asset manager, signed a new partnership to create the world's largest green-bond fund dedicated to emerging markets after raising \$US 1.42 billion.

Looking forward, a significant development will likely be the Action Plan on Sustainable Finance adopted by the European Commission in March 2018<sup>20</sup>. This plan attempts to support sustainable investments by introducing measures related to fiduciary duty, benchmarks, product labels, and the integration of environmental factors into financial risk management. Additionally, the European Commission in July 2018 set up a Technical Expert Group on sustainable finance (TEG)<sup>21</sup> to assist in developing significant reforms including:

- an EU classification system, the so-called EU taxonomy, to determine whether an economic activity is environmentally sustainable;
- an EU Green Bond Standard These proposed reforms were published in mid-2019.

Obviously, the Covid-19 pandemic had an immediate effect on the green bond market. Despite governments issuing bonds at historically high levels, borrowing labelled as green decreased rapidly in the first half of 2020; in fact, the overall supply during the first four months of 2020 fell by 9% compared to the corresponding period of the previous year. Nonetheless, observers were optimistic about the market's prospects and performance: a quick rebound was anticipated as Europe moved up to implement its "Green Deal" and preparations for the COP26 climate change summit were underway and there was also evidence that green bonds outperformed traditional bonds in the turbulent market conditions of March 2020<sup>31</sup>. It turned out that their optimism was well-founded: the market for green bonds did not stop growing and today with many new green initiatives on the agenda and a major environmental awareness, investors expect further expansion in coming years. In particular, the publication of the European Green Bond Standard regulation on 30th November 2023 is likely to increase transparency and product comparability, which will lead to a boost in the green bond market.

## 1.2 Types of Green Bonds

A bond is a traditional financial instrument that dates back to the 13th century *prestiti* (loans) issued by the Venetian government. As a fixed-term IOU between the borrower (issuer) and lenders (investors), bonds are used by corporate and governmental organisations to raise funds from the market. Investors acquire bonds by lending money to

issuers, who promise regular interest payments until the bond reaches its maturity, where the principal is paid in full.

These interest payments offer stable and comparatively secure returns, making bonds a reliable income source within investment portfolios. On the issuer side, bonds often provide more cost-effective capital than traditional bank loans, making them an appealing choice for financing large-scale projects such as renewable energy projects or public transportation infrastructure. Green bonds retain this loan composition and follow convention in the construction of risk and recourse if the borrower defaults on their debt<sup>31</sup>.

The only difference between green bonds and traditional bonds is that the funds raised are specifically directed toward environmental initiatives. Traditional bond investing has a focus on overall company characteristics and credit metrics, instead in this “use of proceeds” approach, investors put more attention on how the money raised is subsequently deployed. Green bonds therefore provide additional information, both on the use of proceeds and on impact reporting, allowing investors to get more closely involved in the environmental efforts that these companies are engaging in.

Interest and principal payments on the bond are generally paid using the company’s overall cash flows, and not by the specific green project. This means that green bonds rank *pari-passu* to conventional bonds. Credit risk is thus contingent on the company’s overall creditworthiness rather than specific project risk<sup>33</sup>.

As depicted in the table below (1.3), there are four types of green bonds in use, and they are primarily differentiated by the scope of legal recourse. Most green bonds are “Use-of-Proceeds Bonds”, also known as corporate bonds. In this case, bond proceeds are earmarked for green projects in the issuer’s portfolio and investors have recourse to the issuer’s entire balance sheet in case of default (so they are defined as standard recourse-to-the-issuer debt).

Figure 1.3: Main features of the most used types of green bonds

| Green Bond Type              | Key Features  |
|------------------------------|---|
| Use-of-Proceeds Bond         | <ul style="list-style-type: none"> <li>• Proceeds are earmarked for green projects in the issuer’s portfolio</li> <li>• Recourse it to the issuer’s entire balance sheet</li> </ul>   |
| Use-of-Proceeds Revenue Bond | <ul style="list-style-type: none"> <li>• Proceeds are earmarked for green projects in the issuer’s portfolio</li> <li>• Recourse is limited to an issuer’s pledged revenue stream, not its entire balance sheet</li> </ul>  |
| Project Bond                 | <ul style="list-style-type: none"> <li>• Proceeds are earmarked for a specific project or group of projects</li> <li>• Recourse is limited to those project(s) assets and balance sheet</li> </ul>  |
| Securitized Bond             | <ul style="list-style-type: none"> <li>• Bond is collateralized by one or more revenue-generating green project, e.g., loan repayments on rooftop solar packages</li> <li>• Project revenue is used to repay the bond, and recourse is limited to the collateralized asset</li> </ul> |

Source: Cortellini, *Green Bond: A Systematic Literature Review for Future Research Agendas*, 2021

Instead, a green “Use-of-Proceeds Revenue Bond” is a non-recourse-to-the-issuer debt obligation in which the credit exposure in the bond is to the pledged cash flows of the revenue streams such as fees and taxes and it may finance or refinance green projects.

The proceeds are moved to a sub-portfolio or otherwise tracked by the issuer and attested to by a formal internal process that will be linked to the issuer’s lending and investment operations for projects. States and municipalities often opt for this type of setup when issuing green bonds<sup>37</sup>.

While “Project Bonds” are backed by earnings of a single project or multiple projects. The proceeds of these projects are distributed through a special purpose vehicle (SPV). An SPV is a subsidiary of the bond issuer (public or private) that has a legal status that allows it to fulfil its obligations even if the parent issuer goes bankrupt. If multiple projects are grouped and collateralized, this type of green bond is called “Securitized bonds”, which include covered bonds, asset-backed securities, and other structures. The first source of repayment is generally the cash flows of the assets securing the bonds. Asset-backed securities (ABS) are often used to fund projects like wind farms, or energy efficiency assets such as solar panels; whereas regarding covered bonds the issuer secures them with a pool of underlying assets that will cover the bond in case the issuer becomes insolvent.

Actually, according to the CBI, this classification can be extended, in fact also loans represent a green bond’s type, and they can be secured (backed by collateral) or unsecured. With unsecured loans, lenders have full recourse to the borrower’s assets. For secured loans, lenders can access the collateral<sup>10</sup>.

Furthermore, as a consequence of innovation in the instrument of green bonds, *De Spiegeleer and Schoutens, (2019)* have documented a variant of “vanilla” green bonds, known as Reverse Green Bonds<sup>7</sup>. Investors in this asset class require a higher yield because they bear the additional risk of missing out on a coupon payment, linked to an ESG company performance, or even forgoing the complete face value of the bond if the issuer misses a pre-agreed climate trigger<sup>15</sup>. Consequently, a failure to meet a specified climate target has a direct negative impact on the cost of capital of the company: it will end up paying more to borrow money.

### 1.3 Main Green Bond Indices

An index is a group or basket of securities, derivatives, or other financial instruments that represents and measures the performance of a specific market, asset class, market sector, or investment strategy<sup>41</sup>.

Since March 2014, several rating agencies and financial institutions have created indices covering green bonds exclusively. The launch of numerous green bond indices was a sign of the market’s growing maturity, and their emergence has broken down previous barriers for institutional investors, such as a lack of understanding of the types of green bonds and a lack of clear risk and performance data about them. Green bond indices simplify tracking green bond performance and comparing it to other investments, offering investors insights into market trends and allowing them to diversify risks by investing in a portfolio of such bonds. They serve as certification institutions, each with its selection criteria and extra factors like size, liquidity, and specific industry sectors for proceeds use. Index providers, aligning with the Green Bond Principles, continuously monitor and adjust their indices, thus contributing to market transparency and credibility<sup>14</sup>.

Moreover, *Doronzo et al., (2021)*<sup>16</sup> observed that, although the growing demand for green bonds is evident in the primary market with bid-to-cover ratios on average higher than ordinary issues, on the secondary market the green indices have been performing similarly to the rest of the global bond sector.

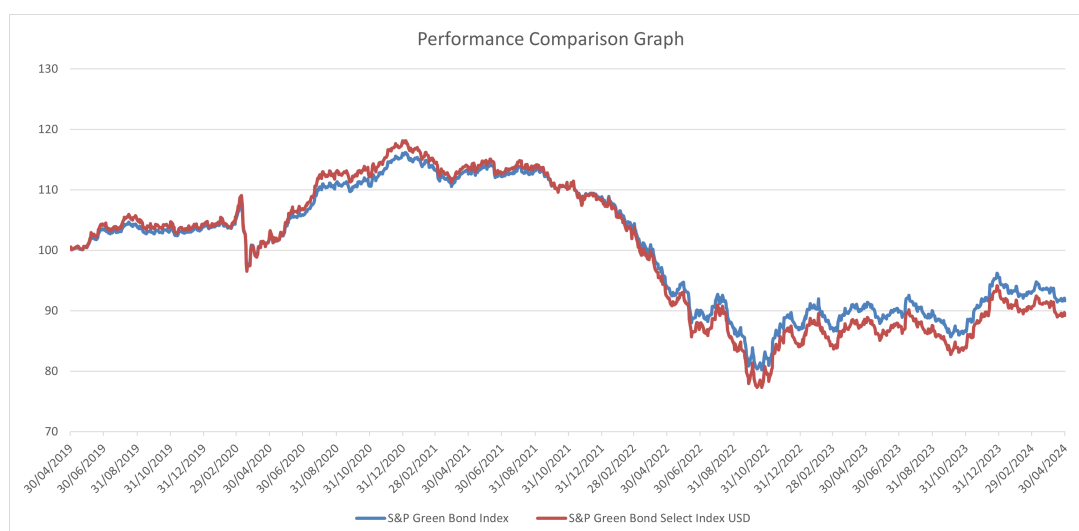
This section provides an overview of the five major green bond indices currently in

place.

- a) **Bloomberg Barclays MSCI Green Bond Index** is a multi-currency market value-weighted benchmark that includes local currency debt markets tracked by the Barclays Global Aggregate Index<sup>25</sup>. This index comprises corporate, government-related, treasury and securitized bonds categorized as green by MSCI ESG Research (including energy efficiency, pollution prevention, sustainable water and green building) and that have fixed-rate coupons. This index, calculated in USD, was launched in November 2014 and is rebalanced every month. It does not have a 1-year minimum time to maturity and bonds are held until final maturity<sup>38</sup>. Moreover, fixed minimum issue sizes are set for all local currency markets matching Bloomberg Barclays Global Aggregate Index, such as 300 million for USD and EUR and 200 million for GBPs.
- b) **ICE BofA Green Bond Index**, previously known as Bank of America Merrill Lynch Green Bond Index, is a multi-currency weighted index designed to track the performance of debt issued by corporations and quasi-government, but it excludes securitized and collateralized securities. Its proceeds are used solely to finance projects and activities that promote climate change mitigation/adaptation and other environmental sustainability purposes as outlined by the ICMA Green Bond Principles; however general debt obligations of corporations that are involved in green industries are not included<sup>25</sup>. Qualified securities must include debt payments with fixed coupons and must have at least 18 months to final maturity at the time of issuance and at least one month remaining to final maturity as of the rebalancing date. The index was launched in 2014 and is calculated in USD. Qualifying securities may be denominated in specified developed market and emerging market currencies, that are selected annually. The full market value is US\$ 1 456 166, and the number of issues is 1 868<sup>28</sup>.
- c) **Solactive Green Bond Index**: is a rules-based, market value-weighted index engineered to mirror the green bond market. The index is calculated as a Total Return Index denominated in USD<sup>25</sup>. Computed in USD since March 2014 and published by Solactive AG, it includes green bonds (as defined by the Climate Bonds Initiative) with an amount outstanding of at least 100 million USD and with time to maturity of at least six months (inflation-linked bonds, convertible bonds and municipal bonds are excluded). In addition to its benchmark Green Bond Index, Solactive offers two subindices providing exposure to the investment grade and liquid subsections of the green bond market:
  - **Solactive Green Bond EUR USD IG Index**: is a subset of the Solactive Green Bond Index comprising of investment grade rated bonds denominated in EUR and USD.
  - **Solactive Liquid Green Bond Index**: is derived from the Solactive Green Bond Index by applying stricter liquidity criteria. The index is denominated in EUR.
- d) **S&P Green Bond Index and S&P Green Bond Select Index** are multi-currency benchmarks that include bonds issued in any country and any currency, by multilateral, government and corporate issuers. The S&P Green Bond Index, launched in July 2014, is market-value-weighted and the S&P Green Bond Select Index, launched in February 2017, is modified market-value-weighted, issuers are capped at 10% and the High Yield Portion (i.e. the portion of the index made up of bonds that pay higher interest rates because they have lower credit ratings than

investment-grade bonds) is capped at 20%. One of the eligibility criteria is that bonds must be labelled green by the Climate Bonds Initiative. These bonds pay specific types of coupons (fixed, zero-coupon, step-up, floaters and fixed-to-float) and exclude inflation. Yes, the sentence makes sense but can be slightly refined for clarity and flow. Constructing a side-by-side plot of the performance of both indices demonstrates that their trends are closely aligned, as evidenced by their high correlation of 0.998.

Figure 1.4: Indices performance comparison based on total return (USD), 2019 - 2024



Source: S&P Dow Jones Indices LLC. Data as of April 30, 2024.

Following the visual contrast, the table below provides a detailed comparison of the values for the S&P Green Bond Index and the S&P Green Bond Select Index.

| Index Characteristics<br>(as of 30 April 2024) | S&P Green Bond<br>Index | S&P Green Bond<br>Select Index |
|--|-------------------------|--------------------------------|
| Market value outstanding (USD Million)         | 1 277 221.85            | 1 815 664.09                   |
| Number of constituents                         | 1 563                   | 14 576                         |
| Weighted Average Maturity                      | 10.86 Yrs               | 10 Yrs                         |
| Yield to Maturity                              | 4.22%                   | 4.21%                          |
| Yield to Worst                                 | 4.2%                    | 4.17%                          |
| Modified Duration                              | 6.54                    | 5.96                           |

Table 1.1: Adapted from "Fixed Income S&P Green Bond Index" and "Fixed Income S&P Green Bond Select Index (USD)", S&P Dow Jones Indices

e) **ChinaBond China Green Bond Index and ChinaBond China Green Bond Select Index** are the first indices to capture the development of China's fast-growing Green Bond market. To be eligible for ChinaBond China Green Bond Index a bond must meet one (or more) of these 4 standards:

- Green Bond Category (2015, by Green Finance Committee, China Society for Finance and Banking)
- Green Bond Issuance Guidelines (2015, by National Development and Reform Commission - NDRC)

- Green Bond Principles
- Climate Bond Standards

Instead, for ChinaBond China Green Bond Select Index: a bond is eligible if it meets all the above 4 standards. They were launched in April 2016, calculated in RMB, their weights are updated monthly and it has a maturity of at least one month<sup>25</sup>.

To provide a comprehensive comparison, the following table presents a detailed overview of key values for both indices.

| <b>Index Characteristics<br/>(as of 29 April 2024)</b> | <b>ChinaBond<br/>China Green Bond Index</b> | <b>ChinaBond<br/>China Green Bond<br/>Select Index</b> |
|--|---|--|
| Market value outstanding (100 million yuan)            | 59 771.55                                   | 50 928.29  |
| Average Duration                                       | 6.24 Yrs                                    | 5.54 Yrs   |
| Average Yield to Maturity                              | 2.58%                                       | 2.57%  |

Table 1.2: Adapted from <https://yield.chinabond.com.cn>

## Chapter 2

# Regulations and Guidelines for Green Bonds

The emergence of green bond guidelines stemmed from the green bond market's early stages (2007–2015) which lacked a universally accepted definition of what constituted a green bond. Early GB issuances were largely self-reported, and therefore this lack of clarity exposes issuers to reputational risks, particularly the threat of 'greenwashing', where the environmental integrity of bond proceeds is questioned. In response to these concerns, there has been a concerted effort within the market to develop standardized approaches for evaluating the environmental integrity and impact of green bonds.

The establishment of the Green Bond Principles by the International Capital Market Association (ICMA) in 2014 represented the most significant step towards standardizing the green bond market and enhancing its credibility.

To set up an issuance framework that helps investors assess the greenness of the climate bonds, also Climate Bond Initiative (CBI) established its standard: *The Climate Bonds Standard and Certification Scheme*. The Standard was launched in 2012 by the CBI, a not-for-profit international organisation working to mobilise global capital for climate action. Based on GBPs, the Climate Bond Standard went further, setting a more detailed taxonomy of eligible green projects by sector and requirements to be met for issuers who seek to obtain the Climate Bond Certification. These requirements are separated into pre-issuance requirements, which must be fulfilled by issuers ahead of issuance, and post-issuance requirements, which need to be satisfied by those who want continued certification following the issuance of the bond<sup>9</sup>. The Standard was initially designed to support confidence in the climate change credentials simply of green bonds and other debt instruments, however, the last updated version of 2024 expands certification coverage to general-purpose instruments (such as sustainability-linked bonds), assets and non-financial legal entities<sup>11</sup>

Although the GBPs created a well-recognized standard, many regional green bond regulations have arisen. Several regional standards are based on the general approach of GBPs, but they have their characteristics in terms of eligible green projects and external verification<sup>13</sup>

Choosing domestic guidelines might be a reasonable decision for large domestic markets. Nevertheless, concerning the challenge of international harmonization, domestic taxonomies run the risk of limiting the value of any green certification scheme to the domestic investor base<sup>17</sup>. The most notable are the European Union's Green Bond Standards of the EU High-level Expert Group on Sustainable Finance, China's Green Bond Endorsed Project Catalogue of the People's Bank of China (PBC) and the Green Bond Standards of the Association of Southeast Asian Nations (ASEAN).

In December 2015, PBC published the first official Chinese green bond guidelines. The guidelines set out the official requirements for what projects qualify as green, management of proceeds and reporting. PBC is the regulator overseeing the interbank bond market, which accounts for 93% of outstanding bonds in China. PBC’s guidelines are therefore a resource also for non-financial corporates to refer to, as they offer more extensive guidance on the whole green bond issuance process. Under this Chinese green bond regulation, economic activities are identified based on six environmental objectives, such as climate change mitigation, sustainable use and protection of water and marine resources and waste prevention and recycling<sup>12</sup>

Whereas the ASEAN Green Bond Standards were developed by the ASEAN Capital Markets Forum (ACMF) and are based on the GBPs. They aim to provide more specific guidance on how the GBPs are to be applied across the ASEAN area.

Regarding the European Union’s Green Bond Standards, they will be extensively covered in section 2.2 of this chapter.

Table 2.1 summarizes the leading international and regional green bond guidelines mentioned and discussed so far.

Figure 2.1: Main Green Bond standard initiative worldwide

| Agency (Acronyms)                               | Year (Version) | Initiative                                  | External Review        | Use of Proceeds Allocation  |
|---|----------------|---|------------------------|---|
| International Capital Market Association (ICMA) | 2014 (v 1)     | Green Bond Principles                       | Voluntary              | Do not provide a close taxonomy of eligible green areas   |
|   | 2018 (v 2)     |   |                        |   |
| Climate Bond Initiative (CBI)                   | 2015 (v 2.0)   | Climate Bond Standard                       | Mandatory              | Climate Bond Taxonomy   |
|   | 2017 (v 2.1)   |   |                        |   |
|   | 2019 (v 3.0)   |   |                        |   |
| EU Commission                                   | December 2019  | EU Green Bond Standard                      | Mandatory              | <ul style="list-style-type: none"> <li>• EU green bond proceeds shall finance projects contributing substantially to at least one of the Environmental Objectives as defined in the EU Taxonomy Regulation, not significantly harming any of the other objectives.</li> <li>• Projects shall be complying with minimum safeguards (e.g., international bill of human rights)</li> </ul> |
| People’s Bank of China (PBOC)                   | December 2015  | China Green Bond Endorsed Project Catalogue | Voluntary, recommended | Official list of eligible green areas (China Green Bond Endorsed Project Catalogue)   |
| ASEAN Capital Market Forum (ACMF)               | 2018           | ASEAN Green Bond Standards                  | Voluntary, recommended | Do not provide a close taxonomy of eligible green areas   |

Source: Cortellini, *Green Bond: A Systematic Literature Review for Future Research Agendas*, 2021

To conclude, it’s important to notice that the guidelines compliance and green certifications involve additional costs for green bond issuers, typically ranging from 0.3 to 0.6 basis points of the total amount. These charges could be challenging for small issuers, especially considering, on the one hand, the potentially restricted geographical application of each framework and, on the other hand, the reduced possibility of reaching a more significant number of investors<sup>13</sup>.

## 2.1 Green Bond Principles

The Green Bond Principles are voluntary process guidelines established in 2014 by a consortium of 13 investment banks. Ongoing monitoring and development of guidelines has since moved to an independent secretariat hosted by the International Capital Market Association. The GBPs are intended for broad use by the market: they provide issuers with guidance on the key components involved in launching a credible green bond; they aid investors by promoting the availability of information necessary to evaluate the environmental impact of their green bond investments; and they assist underwriters by offering vital steps that will facilitate transactions that preserve the integrity of the market<sup>2</sup>. The four core components for alignment with the GBPs are:

### a) Use of Proceeds

The cornerstone of a green bond is the utilisation of the proceeds of the bond for eligible Green Projects, which should be appropriately described in the legal documentation of the security. Green Projects include assets, investments and other related and supporting expenditures such as research and development that may relate to more than one category and/or environmental objective. The eligible Green Projects categories include but are not limited to<sup>2</sup>:

- Renewable energy
- Energy efficiency
- Pollution prevention and control
- Environmentally sustainable management of living natural resources and land use
- Terrestrial and aquatic biodiversity
- Clean transportation
- Sustainable water and wastewater management
- Circular economy adapted products, production technologies and processes and/or certified eco-efficient products
- Green buildings

### b) Process for Project Evaluation and Selection

The issuer of a green bond should outline the decision-making process it follows to determine the eligibility of projects using Green Bond Proceeds. The GBPs encourage a high level of transparency, suggesting the supplement of a review by a second party in this step<sup>29</sup>.

### c) Management of Proceeds

The net proceeds of green bonds should be credited to a sub-account, moved to a sub-portfolio or otherwise properly tracked by the issuer and attested to by a formal internal process that will be linked to the issuer's lending and investment operations for Green Projects<sup>2</sup>.

### d) Reporting

Issuers should make, and keep, readily available to date information on the use of proceeds to be renewed annually until full allocation, and on a timely basis in case of material developments<sup>2</sup>.

The key recommendations for heightened transparency are:

1) **Green Bond Frameworks**

Issuers should explain the alignment of their Green Bond Programme in a Green Bond Framework or in their legal documentation, that summarises relevant information within the context of the issuer's overarching sustainability strategy.

2) **External Reviews**

It is recommended that issuers appoint (an) external review provider(s) to assess through a pre-issuance external review the alignment of their Green Bond Programme with the four core components defined above. Post issuance, it is recommended that an issuer's management of proceeds be supplemented using an external auditor, or other third party, to verify the internal tracking and the allocation of funds<sup>2</sup>.

## 2.2 European Green Bond Standards

The European Commission was also concerned by the lack of consistent regulation in green bond issuance, and in July 2018 established a Technical Expert Group on sustainable finance. Their results were published in June 2019: the *"Report on EU Green Bond Standard"*<sup>43</sup>, which proposed creating a voluntary non-legislative EU green bond standard. A usability guide for the EU Green Bond Standard was subsequently published in March 2020, which provided more specific details for issuers, verifiers, and investors. Lastly, in November 2023, the European Green Bond Standard Regulation was published in the Official Journal of the EU and will start applying several months from then, in December 2024. This regulation establishes a set of specific criteria for bond issuers seeking to use the designation "European Green Bond" or "EuGB" for their sustainable bonds.

The EuGB requirements are more vigorous compared to the ICMA's GBPs, aligning with the EU taxonomy. This alignment ensures that proceeds from bond issuance contribute to one of the six environmental objectives outlined in the EU Taxonomy Regulation. The six objectives are climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and protection and restoration of biodiversity and ecosystems<sup>33</sup>.

Additionally, according to the use of proceeds, a EuGB must be fully invested in environmentally sustainable economic activities, that are:

- contributing substantially to an environmental objective;
- not significantly harming the environmental objective;
- being carried out in compliance with the minimum safeguards;
- and complying with technical screening criteria established by the European Commission<sup>23</sup>

Furthermore, the GBS also sets requirements for allocation, impact reporting and supervision of companies carrying out pre and post-issuance reviews at the European level. The European Securities and Markets Authority (ESMA) will be supervising these external reviewers.

EU Sovereigns have some notable flexibilities and exemptions. They are not only exempt from the obligation to produce a Prospectus Directive-compliant prospectus, but

they are also relieved from having to use External Reviewers and can opt to use their auditors instead. Sovereign EuGB issuers also have some flexibility on the use of proceeds such as financing public assets or expenditures that meet or are expected to meet the Taxonomy Regulation requirements, such as tax relief, subsidies, or international support activities.

In conclusion, EuGB will increasingly help issuers and investors over time to issue green bonds with confidence which is also supported by the Corporate Sustainability Reporting Directive (it mandates large and listed companies on regulated markets to disclose sustainability information) and by other remaining parts of the European Green Deal that will come into force from 2024 onwards.

## 2.3 External reviews in the secondary Green Bond Market

Green bonds emerged as self-labelled products. This leads to the risk of “greenwashing” and to many interpretations of what constitutes a green bond<sup>33</sup>. Therefore, as illustrated in the previous sections, several agencies and governments have looked to alleviate these concerns by creating robust and standardised guidelines, such as the Green Bond Principles. Despite adhering to these principles, disputes may arise regarding which projects qualify as environmentally friendly or whether the funds from green bonds are genuinely allocated to the designated projects. To avoid these situations, the Green Bond Principles recommend the use of external reviews. External reviews are a market-based voluntary solution that reduces information asymmetries between issuers and investors, highlighting to investors that the bond proceeds are funding environmentally responsible projects. Thus, bonds without independent external reviews might have a higher risk of greenwashing<sup>1</sup>.

The market for these green reviews and certification schemes is booming. In fact, *Allman et Lock 2022*<sup>1</sup> had found, on average, 72% of corporate green bond issuers commission an external review and 8% obtain a certification from CBI. In 2023 the second-party opinion (SPO) was the preferred type of external review, while rating agencies such as Moody’s and S&P account for 10% of the review market, followed by assurances provided by audit companies. Issuers considering an external review for their green bonds face a trade-off between the cost of additional reporting versus the potential gains in terms of green reputation, better financing conditions, and access to sustainable investors.

External pre-issuance reviews can take various forms: second-party opinions, third-party assurances, and ratings. In addition, certain issuers obtain a certification from the Climate Bonds Initiative.

Second-party opinions, also known as “second opinions,” provide evaluations of the environmental aspects of a green bond or an issuer’s green bond framework. Typically, a sustainability external expert assesses the issuer’s green bond framework and verifies its compliance with the Green Bond Principles. These assessments are carried out by consultants or institutions with recognized expertise in environmental sustainability, including ESG service providers such as Oekom, Sustainalytics, Vigeo Eiris, and DNV GL, as well as scientific experts like CICERO, a climate research institute based in Oslo. In 2023, 51 SPO providers were involved in providing reviews for aligned green instruments. CICERO reviewed 375 instruments followed by Sustainalytics with 255 instruments<sup>36</sup>. CICERO is a leading global provider of SPOs for green bonds, having gained prominence with its introduction of the “Shades of Green” methodology in 2015 (Dark Green, Medium Green, and Light Green), which offers investors better insights into the environmental

quality of green bonds.

The conclusions or opinions provided in SPOs can vary depending on the provider. While CICERO evaluates the level of green commitment, other providers may simply state whether a green bond framework complies with the GBPs or aligns with the issuer’s sustainability strategy. However, SPOs are limited in that they only offer a forward-looking perspective and cannot verify if the green bond proceeds were managed as intended after issuance. Additionally, there can be inconsistencies and a lack of transparency in the assessment methodologies used by opinion providers, and the results of their evaluations are not always made public.

Third-party assurances (or verifications) are conducted by accounting or audit firms like KPMG and Deloitte to determine if a green bond issuance aligns with reputable international frameworks such as the Green Bond Principles. These assurances evaluate various aspects, including the green bond’s criteria, project selection and evaluation processes, internal mechanisms for tracking proceeds, non-financial data on environmental outcomes, and the procedures for preparing progress reports. Assurances constitute approximately 8% of the corporate green bond market, with Big Four (Deloitte, Ernst & Young, KPMG and PwC) firms representing 7.7% of this segment. Deloitte globally dominates the green bond assurance market, holding over 50% of the market share.

Issuers can also obtain green bond ratings (or scores), which focus on green credentials and are distinct from traditional credit ratings. These ratings are generally issued by credit rating agencies, with Moody’s Green Bond Assessment (GBA) and S&P’s Green Evaluations being the most prominent. Moody’s was the first rating agency to publish a methodology for assessing green bonds, aligning broadly with the Green Bond Principles. Moody’s GBA evaluates an issuer’s management, administration, allocation of proceeds, and reporting on environmental projects financed with green bond proceeds. It ranks green bonds on a scale from GB1 (excellent) to GB5 (poor) based on five factors: use of proceeds, ongoing reporting, organization, process management, and disclosure of proceeds’ use.

S&P introduced Green Evaluations in 2017, offering a broader focus than Moody’s GBA by incorporating a technical environmental impact assessment, along with governance and transparency components. S&P’s ratings range from 0 to 100 and evaluate the environmental impact of projects financed by the bond’s proceeds over their lifetime relative to a local baseline. Unlike Moody’s, S&P does not provide an ex-post assessment of the use of proceeds.

Issuers can also certify green bonds against recognized external green standards or labels, such as the Climate Bonds Initiative’s Climate Bond Standards (CBS) and Certification Scheme. Climate Bond Certification requires third-party verification before and after issuance to confirm that the asset adheres to the CBS, which incorporates the Green Bond Principles. An approved external verifier assesses whether the bond meets environmental standards and whether the issuer has the necessary controls and processes in place. The top three CBI certifiers are ISS-Oekom, Sustainalytics, and EY<sup>1</sup>.

Despite the consensus in the existing literature that the existence of a broad network of external reviews plays a crucial role in reducing both information asymmetry and greenwashing, the results vary when investigating the impact of external reviews on the financing costs and green premiums of green bonds. Several studies have investigated this topic with different findings.

*Allman et Lock, 2022*<sup>1</sup> stated that, on average, there is no evidence that external reviews reduce the financing cost of green projects compared to conventional bonds. However, they noted that firms domiciled in common law countries, which are potentially less credible green issuers, benefit from external reviews. Conversely, corporate green issuers

in civil law countries, who are more likely to obtain reviews, do not seem to experience lower financing costs. *Zirek, 2023*<sup>46</sup> corroborates this result, as their study did not find a statistically significant relationship between bond-level certification and the green bond premium, suggesting that certification might not impact financing costs directly. Nevertheless, they noted that firms might use certification to increase attractiveness due to other characteristics like bond domicile and issue size.

In contrast, *Simeth, 2022*<sup>40</sup> found that different types of external reviews can impact the yield spread between green bonds and paired conventional bonds in the secondary market. Specifically, the research noted that an SPO significantly reduces the yield spread due to its ability to provide exhaustive information on the issuer's policies and processes, thereby reducing information asymmetry and environmental risk. This effect is particularly pronounced in the financial industry, where third-party verifications help mitigate environmentally related credit risk and increase investor confidence.

While *Hyun, 2020*<sup>27</sup> provided robust evidence that external reviews with CBI certificates, significantly affect the green bond premium, enjoying discounts of 6 to 15 basis points compared to those without such information, effectively compensating for the additional costs of these reviews.

Overall, these findings suggest that while external reviews and certifications can enhance investor confidence and reduce certain risks, their impact on financing costs varies. Factors such as the type of review, the issuer's credibility, and the geographical and industry context play significant roles. More robust and comprehensive classification systems may be required to fully realize the potential benefits of green bond certifications.

## Chapter 3

# Advantages and Limitations of Green Bonds

As awareness of sustainability grows, green bonds have emerged as an attractive asset class for ethical investors who prioritize environmental mandates. These investors include institutional players such as pension funds, sovereign wealth funds, insurance companies, mutual funds, investment banks, international organizations, and governments.

For investors, green bonds provide several financial benefits. They generally come with lower risk, higher returns, and better diversification compared to conventional bonds. The transparency regarding the environmental impact and the specific use of proceeds is an additional value, allowing investors to make more informed decisions and better understand the strategies and environments of issuers. This improved information can enhance investment strategies and risk assessments.

However, ethical investors face the challenge of verifying the environmental integrity, or "greenness," of these bonds. The need to evaluate green reports relying on independent verifiers introduces additional costs and complexities. This information asymmetry can limit the universe of reliable green bonds, increasing demand and reducing yields on these bonds, which can, in turn, limit returns and portfolio diversification.

As discussed in the previous chapter, mechanisms to standardize and enhance information, such as greenness standards, external reviewers, green indexes, and certificates, can help overcome these challenges.

Despite these efforts, green bonds still face some obstacles for investors. These include the low impact of investors' pro-environmental preferences on bond prices, significant volatility clustering, lack of suitable institutional arrangements, the aspect of minimum size, and the associated higher transaction expenses. These limitations suggest that further efforts are needed to improve the productivity of green bonds in financial management.

Regarding issuers, they also benefit significantly from green bonds: they can attract a broader investor base interested in sustainability, reduce capital risk, and improve access to capital. Green bonds improve the issuers' reputation and align their financial strategies with environmental goals.

In addition to individual benefits, green bonds offer systemic advantages. They help to bridge knowledge and capacity gaps on ESG issues, improve the match between investor expectations and available green investment opportunities, and increase the overall efficiency of capital allocation. By improving the knowledge of underlying investments, green bonds can lead to better investment decisions and a stronger link between securities and tangible green projects.

Along with financial incentives, green bonds offer significant non-financial benefits.

Issuing green bonds allows organizations to communicate their sustainability efforts to external stakeholders and clients. This acts as a quality assurance stamp, demonstrating a firm's commitment to environmental sustainability, which can ensure client loyalty. Main non-financial advantages include brand building, risk reduction, operational efficiencies, and the creation of new markets. For issuers, green bonds can enhance brand reputation, attracting new customers interested in sustainable finance and allowing for premium pricing of their products or services. Operational efficiency can be improved as employees become more motivated by their organization's commitment to sustainability, attracting high-quality talent. Additionally, issuing green bonds helps manage non-financial risks, such as reputational risks and future regulatory changes related to sustainability.

However, while green bonds provide financial and non-financial advantages, they alone cannot drive the low-carbon transition. Policymakers must integrate green bonds into broader climate and economic policies to incentivize the development of green projects and ensure they provide necessary returns for investors. An overall approach that addresses the entire financial value chain is essential for maximizing the potential of green bonds in promoting sustainable development.

### 3.1 Benefits for shareholders and corporations

The issuance of corporate green bonds has become more prevalent over time, particularly in industries where the natural environment is financially material. Corporate green bonds are debt securities issued by corporations to finance environmentally friendly projects. These bonds aim to improve companies' environmental footprints while contributing to their financial performance. Recent empirical studies exploring why firms issue green bonds reveal two main key insights. First, when firms announce the issuance of certified green bonds and the projects they will finance, their stock prices tend to rise. Studies show significant abnormal stock returns ranging from 0.5-1.5% around these announcements.

Secondly, issuing certified green bonds does not result in significantly lower financing costs for firms. The green bond yield spread is minimal, estimated between 0 to 0.2%. This, along with qualitative industry evidence, suggests that concerned investors do not currently have a substantial impact, nor does bond default risk. The negligible yield spread indicates that green bonds do not greatly affect firms' repayment capacity<sup>14</sup>.

Research in the literature highlights several benefits of corporate green bonds. *Flammer's (2020)*<sup>24</sup> study, based on a sample of 368 corporations from 2013 to 2016, shows that these bonds help companies and the environment by enabling the private sector to combat climate change effectively, independent of government actions. Issuing green bonds attracts investors who prioritize long-term sustainability, indicating that these bonds have a real impact and are not merely a greenwashing tool.

Additionally, *Daubanes et al., (2021)*<sup>14</sup> developed a relationship between the proportion of green bonds issued in an industry, the carbon price applied to that industry, and managers' concern for their firms' stock price. Their findings suggest that managers' sensitivity to stock prices positively influences green bond issuance due to the interplay between managerial incentives and carbon prices. This positive effect indicates that the recent surge in certified green bonds is driven primarily by short-term financial incentives.

The study draws the following conclusions:

- Certified green bonds, although voluntary, can encourage companies to engage in effective carbon reduction projects. Announcements of certified green projects convey positive information about their profitability, which is reflected in abnormal stock

returns.

- Financial short-term interests are likely to drive companies' incentives to issue green bonds.
- Green bonds support carbon pricing and have important practical implications. Governments cannot rely on green bonds alone without carbon penalties; high carbon prices increase the effectiveness of green bonds.

Instead, *Tang & Zang, (2020)*<sup>42</sup> examine how the issuance of green bonds affects the stock valuation of companies. They identify three main channels through which green bonds can affect stock prices:

- **Financing cost channel:** The idea here is that socially responsible investors seek out green bonds to improve their ESG scores, thereby increasing demand and lowering issuers' cost of capital. However, the study finds little evidence to support this channel as the primary driver of positive stock market reactions to green bond announcements.
- **Investor attention channel:** Green bond announcements increase media attention and signal green investment opportunities to the market, thereby broadening the investor base. *Tang & Zhang, (2020)* observe a significant increase in stock market turnover around the issuance month and a notable increase in domestic institutional ownership, suggesting that investor attention plays a key role in the positive market reaction.
- **Firm fundamental channel:** Green bonds highlight a company's commitment to sustainable development and potential for future positive cash flows. The study finds improvements in stock liquidity after issuance, suggesting that green bonds can attract more investors and stock market transactions, supporting the investor attention channel rather than the firm fundamental channel.

Overall, *Tang & Zhang, (2020)* conclude that green bonds enhance shareholder value primarily through increased investor attention and improved stock liquidity, rather than through lower financing costs. Their findings suggest that green bond issuance provides net benefits to existing shareholders by attracting more media attention and institutional investment.

## 3.2 Greenwashing Concerns in Green Bond Market

Despite the above advantages, issuing green bonds may also involve the negative practice of greenwashing. This refers to the process of conveying misleading information about the extent of an issuer's environmental or social commitment by deceptively announcing but not effectively implementing the sustainable projects meant to be financed through green bonds. Four situations in which issuers can be accused of greenwashing are described by *Bartels et al., (2015)*<sup>19</sup>.

1. The investment community may believe that bond proceeds have been used to fund activities that were not sufficiently 'green'.
2. The core business of the green bond issuer may be perceived to be unsustainable, as is the case with the issuance of green bonds by oil and gas companies.
3. Green proceeds may not be sufficiently tracked or managed to ensure that they are used only for the intended project.

4. Issuers may have difficulty in demonstrating that the proceeds have been used for the achievement of green objectives and that the project has had a significant impact on the environment.

Although empirical evidence on greenwashing is still limited, its diffusion should not be underestimated, especially considering the growing issuance of green bonds in the private sector, where such deceptive strategies are less subject to investor control mechanisms. The greenwashing expansion is indeed demonstrated by *Shi et al., (2023)*<sup>39</sup> findings, which indicate that particularly companies in heavily polluting sectors and with lower levels of human capital, tend to prioritize the quantity rather than the quality of green innovation when utilizing funds raised through green bonds. This behaviour suggests that companies aim to create an image of being environmentally conscious by superficially increasing the number of green patent applications, without actually making substantial improvements to their green innovation capabilities.

Investors are likely to require higher premia to offset the increased risk of greenwashing by issuers. Among corporations, the greenwashing risk is greater in manufacturing firms than in service firms, but it is especially significant in the financial sector. On the public side, multinational or sovereign issuers are more inclined to greenwashing compared to local governments, as their greater distance from communities enables them to avoid investor examination. For investors, who allocate capital to green bonds issued by service firms, is easier and more immediate to monitor potential greenwashing activities post-issuance. For instance, if a firm announces the construction of a sustainable infrastructure project before issuance but after it fails to fulfil these promises, it becomes evident. In fact, a utility company that issues a green bond for a photovoltaic park would struggle to divert funds to a non-sustainable project without detection. Consequently, the risk of greenwashing is lower in the services sector, leading investors to accept lower returns since monitoring these activities is less costly and time-consuming<sup>4</sup>.

*Baldi and Pandimiglio's*<sup>4</sup> analysis advises investors seeking to minimize their exposure to greenwashing risk to consider investing in public sector green bonds issued by local governments and corporate green bonds issued by service sector firms. Additionally, investors are encouraged to target public green bonds with larger original issuance sizes, as these are expected to have a greater impact on the sustainability of the target territory through the financed infrastructure project. Furthermore, investors should prioritize purchasing both public and corporate green bonds with an ESG rating, as the availability of such ratings reduces information asymmetries between investors and issuers regarding the expected sustainability benefits associated with the financed project for the target community.

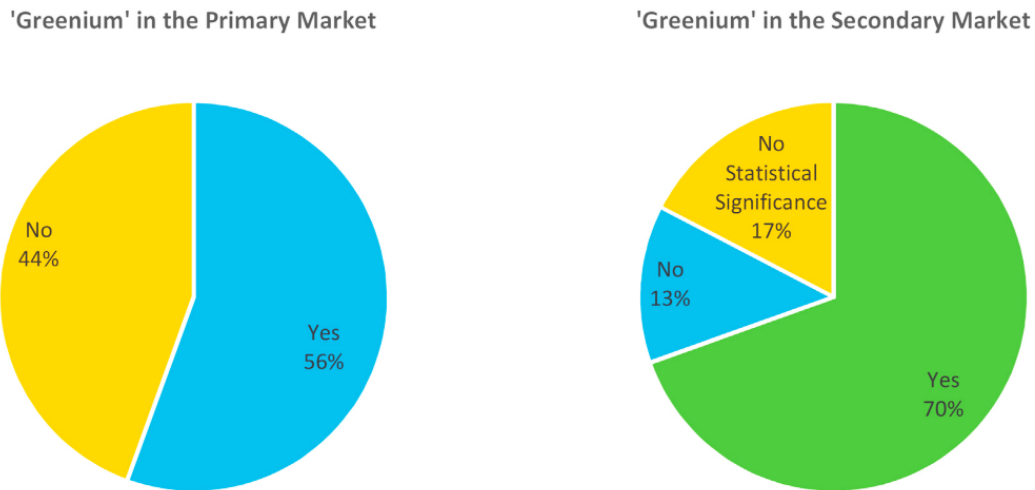
## Chapter 4

# Comparison between green and conventional bonds

The expansion of the green bond market in recent years has generated significant interest in understanding the true characteristics of green bonds and how they compare to traditional bonds. Figuring out these aspects is crucial for assessing the risk-return profile of green bonds and their susceptibility to external shocks in comparison to conventional bonds. To discern the differences between green and conventional bonds, many researchers have studied the phenomenon of greenium for some time now. The greenium of a green bond is defined as the extra spread a green bond pays compared to a similar non-green bond with the same maturity, seniority, and currency. So, this term describes the price advantage associated with the belief that investors are willing to pay more or accept reduced yields in order to support sustainability. The main debate that has arisen concerns the existence of the greenium. From the studies in the literature, this topic appears quite controversial since there is no global consensus on the existence of a green premium. Despite this, in the next paragraph, we will examine the extent and reasons why the greenium, when acknowledged, tends to be negative. This overview will be based on selected papers that examine a sample of data from the secondary market concerning green bonds issued worldwide. There are differences in the analysis of price premiums between the primary and secondary markets: in fact, a varied but generally positive consensus emerges from the studies focused on the existence of a green premium in the primary green bond (GB) market and reviewed by *McAskill et al., (2020)*<sup>34</sup>. Some investors demonstrate a willingness to pay a higher price for GBs, thereby accepting lower yields compared to comparable conventional bonds (CBs). These findings carry practical implications for issuers and the broader development of the GB market. As awareness grows among issuers regarding the potential capital-raising advantages of the green premium, implications for the overall growth of the GB market become apparent. Instead, the literature reveals a more pronounced consensus regarding a green premium within the secondary market. Moreover, a consistent green premium in the secondary market could exert pressure on future primary market issuance prices, as secondary market prices serve as a gauge of market tolerance.

There are also different reasons why the cost advantage should exist from both the investor's and the issuer's perspectives. The observable yet modest greenium for issuers should be seen as a positive factor, potentially offering further motivation to invest in sustainable projects. However, issuers need to maintain a balanced perspective. The increased costs associated with issuance and compliance (such as certification and reporting for green bonds) must be carefully weighed in the overall evaluation. Only then can a comprehensive assessment determine whether the breakeven point has been achieved or,

Figure 4.1: Literature consensus on the existence of a green premium in the primary e secondary market



Source: MacAskill, *Is there a green premium in the green bond market? Systematic literature review revealing premium determinants, 2020*

optimistically, even surpassed. From an investor’s perspective, the rationale behind the greenium is intricate. Specifically, the factors contributing to higher returns have not been clearly identified in research. Currently, the explanations provided are largely indirect and may not be strictly financial. The argument is that although investors may accept lower yields on green bonds in the short term, the environmental and social benefits will show up over the medium to long term, presenting challenges in quantification.

## 4.1 Does a Greenium Exist?

Many authors detected the existence of the green bond premium at the issuance of green bonds (primary market) and on an ongoing daily negotiation (secondary market). Focusing on green bond pricing in the secondary market, the consensus on the emerging phenomenon, as indicated in the table, is not uniform; in this analysis, 4 out of 7 papers confirm the existence of a negative premium, suggesting that investors are willing to accept a lower return in exchange for the environmental benefits provided by green bonds.

Figure 4.2: Green premium empirical literature

| Author(s) (Year)                   | Time Span   | Geographical scope | Sample Size  | Market Segment   | Methods   | Greenium evidence | Premium dimension  | Level of Statistical Significance |
|------------------------------------|-------------|--------------------|--|------------------|---|-------------------|--|-----------------------------------|
| Hachenberg and Schiereck (2018)    | 2015–2016   | World              | 63   | Secondary market | Matching method, yield curve, Wilcoxon test, Panel regression model                             | Controversial     | - 1.18 bps (entire sample)   | n.a.                              |
| Zerbib (2019)                      | 2013–2017   | World              | 110  | Secondary market | Matching method, Fixed effect panel regression  | Yes, negative     | - 2 bps (in the entire sample)   | 1%                                |
| Ma et al. (2020)                   | 2016–2020   | World              | 521  | Secondary market | Hypothesis Tests  | Controversial     | Fluctuate near zero over time, with an overall average around - 7.07 bps   | n.a.                              |
| Hyun et al. (2020)                 | 2010–2017   | World              | 60   | Secondary market | Matching method, OLS, and fixed effects generalized least squares (FGLS) regression model       | Controversial     | - 6 bps (in case of third party verification)<br>- 15 bps (in case of CBI certification)                               | 1%                                |
| Immel et al. (2021)                | 2017–2019   | World              | 466  | Secondary market | OLS regression  | Yes, negative     | Between - 8 bps and - 14 bps   | 1%                                |
| Kaupran and Scheins (2021)         | 2013 - 2020 | World              | 431  | Secondary market | Matching method, fixed effect panel regression  | Yes, negative     | - 3.6 bps when GB is listed on an exchange with a dedicated Green market segment, and - 4 bps when the GB is certified | no significance                   |
| Ayaydin Hacımeriçliu et al. (2022) | 2013–2019   | World              | 563 green bonds and 12,197 brown bonds of the same issuers | Secondary market | Matching method, OLS with heteroskedasticity-consistent standard errors, Panel regression model | Yes, negative     | Green bonds trade at lower returns, especially during the first half of the sample period                              | 5%                                |

Source: Adapted from: Cortellini, *Green Bond: A Systematic Literature Review for Future Research Agendas, 2021*

*Zerbib, (2019)*<sup>45</sup> detected a small negative premium of about 2 bps (green bonds priced tighter than conventional bonds) and shows that the premium is greater for financial firms and low-rate bonds. The negative green bond premiums observed in several market segments indicate that the buying pressure for green bonds exceeds the supply capacity, compared to conventional bonds. This market microstructure discrepancy can be attributed to two phenomena, which are not mutually exclusive: an excess of investment demand due to the inherent specificity of green bonds and an insufficiently large volume of bond issuances.

*Immel et al., (2021)*<sup>30</sup> examined the existence and magnitude of the greenium based on the green bond's degree of greenness, measured by ESG ratings. The study found that green bonds issued by ESG-rated issuers experienced a higher negative premium (ranging from  $-9$ . to  $-19$  bps) compared to un-rated green bond issuances (ranging from  $-8$  to  $-14$  bps). Additionally, the research indicated that a higher ESG rating corresponds to a larger negative green bond premium. Within the ESG rating, the G-score (reflecting the issuer's governance characteristics) was identified as the primary driver of the green bond premium.

*Kaupran and Scheins, (2021)*'s findings<sup>32</sup> indicate that the presence and significance of the Green premium vary considerably across different currencies and issuer types. The premium is notably high and significant for bonds issued by social entities such as governments or supranationals and for bonds denominated in EUR. Conversely, for corporate green bonds, additional verification of green credentials is necessary. This pattern is observed in secondary markets, where 431 matched pairs of green and conventional bonds from the same issuer were analyzed. Specifically, the study found that the green credibility of a bond, as indicated by factors such as listing on a green exchange, the size of the issue (and thus indirectly the environmental impact of the green bond), and the sustainable reputation of the bond's issuer, significantly reduces the yield differential between green and conventional bonds.

Finally, also *Haciömeroğlu et al., (2022)*<sup>3</sup> finds a possible difference between green and brown bonds based on their secondary market yields, in which the efficient frontiers constructed suggest that green bonds trade at lower returns, especially during the first half of the sample period.

In conclusion, a negative green bond premium benefits issuers of green bonds. They can take advantage of this situation because the market can handle more green bonds being issued. This is good news for companies focusing on green projects because they can borrow money at lower cost, as currently green bonds are issued with interest rates similar to regular bonds from the same issuer that have similar features. However, a negative green bond premium makes investors less interested if they don't have to invest in green assets. This is especially true for traditional pension funds and insurance companies whose investment committees haven't made it mandatory to invest in green capital. Besides reducing funding for low-carbon projects, a negative premium could mean that only a few existing green investors hold green bonds. This might make it harder for regular investors to access green funds. If more institutional investors join in investing in green bonds, it could make green funds more accessible to regular investors who want to invest in green projects.

On the contrary, alternative authors found controversial results when investigating the greenium in the secondary market. *Hachenberg and Schiereck, (2018)*<sup>26</sup> discovered that, on average, green bonds are priced approximately 1 basis point tighter than conventional bonds when analysing a sample of 63 global investment-grade green bonds. However, their findings diverge across different rating classes: AAA-rated bonds are priced wider than

their non-labelled counterparts, while AA-BBB-rated green bonds exhibit a greenium; and issuer industries: government-issued bonds trade marginally wider, while corporate and financial issuer trade tighter than their non-green equivalents. Furthermore, the study observes that possessing an ESG rating diminishes the negative premium, suggesting that this could be attributed to the fact that investors focused on ESG criteria may not always require a green bond from an issuer with an ESG rating to align with their investment policies. Therefore, the presence of an ESG rating may enable investors to opt for the conventional bond instead.

Similarly, *Hyun et al., (2020)*<sup>27</sup> did not find a consistent and significant yield premium or discount on average when comparing the liquidity-adjusted yield premiums of green bonds versus conventional synthetic bonds. However, the authors identified a greenium in cases where green bonds were certified by an external reviewer (6 basis points) and when certified by CBI (15 basis points). Further research is needed to focus on a deeper exploration of the secondary markets of green bonds, aiming to provide a more conclusive understanding of the greenium phenomenon, taking into account geographical variations in capital market development, regulations, and applicable standards.

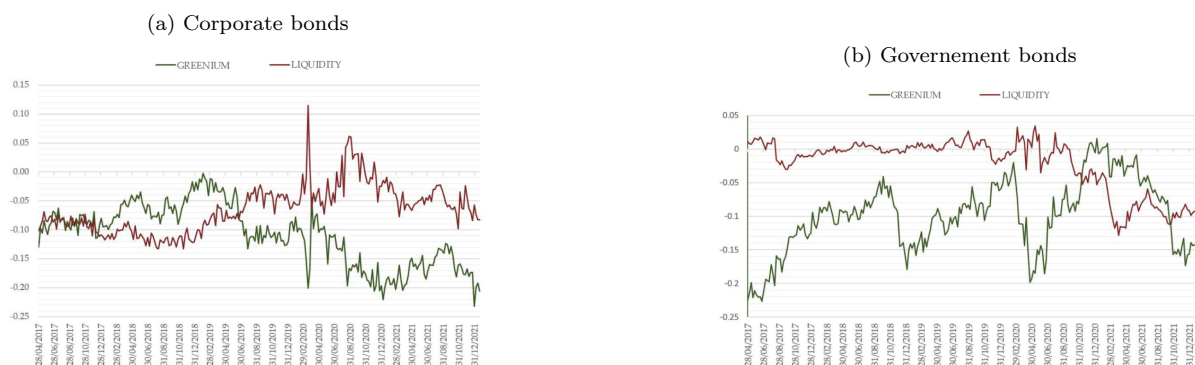
## 4.2 Performances during Covid-19 pandemic

The COVID-19 pandemic began in early 2020 and started impacting financial markets by the end of February that year. This global health crisis not only caused widespread public health emergencies but also had a significant effect on market prices. As the pandemic developed, it became crucial for researchers to examine whether the performance of green bonds in both primary and secondary markets was influenced by these challenging market conditions.

The analysis in the literature of how green bonds reacted to the COVID-19 pandemic reveals the following findings: most agree on the resilience of green bonds during the COVID-19 pandemic, highlighting that green bonds were less affected by market volatility compared to non-green bonds. There is a consensus that the unique investor base of green bonds, which is driven by non-pecuniary motives such as environmental concerns, played a significant role in their stability. This investor behaviour led to a sustained demand for green bonds during the pandemic. Regarding this strong demand, *Ma et al., (2020)*<sup>33</sup>, *Haciömeroğlu et al., (2022)*<sup>3</sup>, and *Arat et al., (2023)*<sup>18</sup> argue that it is because the greenium remained significant or increased, indicating continued investor interest. Moreover, the long-term strategic approach of investors has preserved the resilience of green bonds. In fact, both *Ma et al., (2020)* and *Naeem et al., (2021)*<sup>35</sup> mention that green bond investors are more focused on long-term gains and less on immediate market fluctuations. According to *Ma et al., (2020)*, the resilience shown by green bonds in the early stages of market distress is also attributed to the fact that in general ESG-focused strategies continued to see net inflows during the crisis. As a result, the spreads of ordinary bonds widened due to selling pressure and flight to cash, causing the greenium to become more negative and emphasizing the robustness of sustainable investments during systemic crises.

In addition, Intonti analyzed to investigate how the greenium changed during the COVID-19 pandemic, covering the period from 2017 to 2021. In the phase before COVID-19, the greenium tended to have a higher value, indicating a lesser impact. However, during the pandemic, this difference sharply decreased, resulting in a higher premium value. Overall, government bonds exhibited a wider differential compared to corporate bonds (pre- to post-pandemic values for government bonds shifted from  $-0.1782$  to  $-0.1803$ , while for corporate bonds they moved from  $-0.11$  to  $0.006$ ). This highlights the pandemic's significant impact on the greenium, with higher values observed in government bonds and lower values in corporate bonds.

Figure 4.3: Greenium and liquidity trends by issuer's type



The evolution of the greenium (in green) and liquidity (in red) of corporate bonds calculated through OLS regression for each moment.

The evolution of the greenium (in green) and liquidity (in red) of government bonds calculated through OLS regression over time.

Source: Intonti et al., *The “Greenium” in Green Bonds: How Did It Change with COVID-19?*, 2023

Furthermore, in the case of government bonds, the fluctuation and development of the differential were not found to be influenced by changes in liquidity due to the interest rate crisis. Indeed, the liquidity ratio was quite minimal and statistically insignificant for government bonds before the pandemic, and even lower than that observed for corporations in the subsequent period (with a pre-pandemic value of 0.383 decreasing to 0.310 post-pandemic). The results from these studies indicate that although both green and brown bonds experienced a reduction in their primary market yields during the pandemic, the decline for green bonds was somewhat more pronounced, even leading to an increased greenium during the pandemic.

# Conclusions

In recent years, issues such as pollution and global warming have become increasingly severe, necessitating urgent intervention to improve the situation. The finance sector has responded positively to this challenge; as early as the 1980s, a new segment emerged: sustainable finance. Many instruments are part of this effort, but Green Bonds are particularly suited to promote investments with a positive environmental impact. The empirical analysis conducted in this thesis aimed to analyze the main characteristics of green bonds, providing a comprehensive view of the fundamental aspects of this relatively recent financial instrument. Green Bonds are financial instruments similar to traditional bonds, except that the funds raised must be exclusively used to finance environmental projects. Investors receive repayment of the principal at maturity and periodic interest payments during the bond's term.

Therefore, it was interesting to study the comprehensive landscape of green bonds, encompassing their market evolution, their various types, and the influential indices that measure their performance. Additionally, exploring the regulatory framework, including a focus on Green Bond Principles and European standards, as well as the role of the different types of external reviews, was crucial. Understanding the benefits they offer to shareholders and corporations, along with their environmental impact, highlighted their potential but also raised concerns about greenwashing within the market. Furthermore, this analysis explores whether it is advantageous for the involved parties to use this type of instrument. Drawing from existing literature, a comparison was made between their financial characteristics and those of conventional bonds, investigating the presence of a greenium and revealing a slight prevalence of results indicating a negative premium. This is because investors are willing to accept a slightly lower return compared to traditional bonds. After all, they are rewarded by the positive environmental impact. Issuers, on the other hand, can benefit from a slightly lower cost of debt provided they finance projects with specific environmental goals. Finally, the last step was to assess their resilience during the COVID-19 pandemic and discover that, compared to traditional bonds, they exhibited better resilience despite the impact this emergency had on financial markets.

Thus, green bonds have shown to be an instrument that integrates finance and business with an environmentally conscious approach from all stakeholders and financial institutions.

Despite their potential, an appropriate ecosystem is needed to ensure their efficacy in both developed and developing nations, along with a clear policy signal. In fact, geographically, green bonds are still predominantly concentrated in developed countries, while the markets for green bonds in most developing nations are still in a nascent state. More efficient disclosures through credible certification, reduced issuance costs via tax incentives, improved policy coordination to build the capacity of financial institutions, and increased awareness for environmental investments can help boost the green bond market. In any case, the long-term benefits that green bond financing and investing will bring to the economy and the environment remain to be seen, awaiting further studies

to assess their impact on sustainable development goals, such as those established by the United Nations.

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# Bibliography

- [1] Elsa Allman and Brandon Lock. External Reviews and Green Bond Credibility. *Journal of Climate Finance*, 2002.
- [2] International Capital Market Association. Green bond principles voluntary process guidelines for issuing green bonds. <https://unfccc.int/resource/docs/2015/cop21/eng/109r01.pdf>, 2021.
- [3] Hande Ayaydın Hacıömeroğlu, Seza Danişoğlu, and Z. Nuray Güner. The grass is greener on the other side: Comparison of green versus brown corporate bonds. *Borsa Istanbul Review*, 22(6):1182–1194, November 2022.
- [4] Francesco Baldi and Alessandro Pandimiglio. The role of esg scoring and greenwashing risk in explaining the yields of green bonds: A conceptual framework and an econometric analysis. *Global Finance Journal*, 2022.
- [5] Umair Saeed Bhutta, Adeel Tariq, Muhammad Farrukh, Ali Raza, and Muhammad Khalid Iqbal. Green bonds for sustainable development: Review of literature on development and impact of green bonds. *Technological Forecasting and Social Change*, 175:121378, 2022.
- [6] Carlotta Michetti, Neeraj Chouhan, Caroline Harrison, Matthew MacGeoch. Sustainable debt global state of the market 2022. [https://www.climatebonds.net/files/reports/cbi\\_sotm\\_2022\\_03e.pdf](https://www.climatebonds.net/files/reports/cbi_sotm_2022_03e.pdf), 2023.
- [7] Chiyoung Cheong and Jaewon Choi. Green bonds: a survey. *Journal of Derivatives and Quantitative Studies: 선물연구*, 28(4):175–189, 2020.
- [8] Climate Bond Initiative. Today at cop21: 27 global investors representing \$11trn aum back paris green bonds statement. <https://bit.ly/3W07tTv>. 2015-09-12.
- [9] Climate Bond Initiative. Climate bonds standard - version 2.1. <https://www.climatebonds.net/climate-bonds-standard-v21>, 2017.
- [10] Climate Bond Initiative. Explaining green bonds. <https://www.climatebonds.net/market/explaining-green-bonds>, 2020.
- [11] Climate Bond Initiative. Climate bonds standard - version 4.1. <https://www.climatebonds.net/standard/climate-bonds-standard-41>, 2024.
- [12] Climate Bond Initiative and International Institute for Sustainable Development. Roadmap for china: green bond guidelines for the next stage of market growth. [https://www.climatebonds.net/files/files/CBI-IISD-Paper1-Final-01C\\_A4.pdf](https://www.climatebonds.net/files/files/CBI-IISD-Paper1-Final-01C_A4.pdf), 2016.
- [13] Giuseppe Cortellini and Ida Claudia Panetta. Green Bond: A Systematic Literature Review for Future Research Agendas. *Journal of Risk and Financial Management*, 14(12):589, December 2021.

- [14] Julien Xavier Daubanes, Shema Frédéric Mitali, and Jean-Charles Rochet. Why Do Firms Issue Green Bonds? *Swiss Finance Institute Research*, 2021.
- [15] Jan De Spiegeleer and Wim Schoutens. Sustainable Capital Instruments and Their Role in Prudential Policy: Reverse Green Bonds. *SSRN Electronic Journal*, 2019.
- [16] Raffaele Doronzo, Vittorio Siracusa, and Stefano Antonelli. Green Bonds: The Sovereign Issuers’ Perspective. *SSRN Electronic Journal*, 2021.
- [17] Torsten Ehlers and Frank Packer. Green bond finance and certification. *BIS Quarterly Review*, page 16, September 2017.
- [18] Arat et al. Greenium, credit rating, and the covid-19 pandemic. *Journal of Asset Management*, 2023.
- [19] Bartels et al. Sustainable Insight: Gearing up for Green Bonds. *KPMG INTERNATIONAL*, 2015.
- [20] European Commission. Action plan: Financing sustainable growth. <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52018DC0097>, 2018.
- [21] European Commission: Directorate-General for Financial Stability, Financial Services and Capital Markets Union. Technical expert group on sustainable finance (teg). [https://finance.ec.europa.eu/publications/technical-expert-group-sustainable-finance-teg\\_en](https://finance.ec.europa.eu/publications/technical-expert-group-sustainable-finance-teg_en), 2018.
- [22] European Environment Agency. 8th environment action programme green bonds. <https://www.eea.europa.eu/publications/european-union-8th-environment-action-programme/indicators/21-green-bonds-indicator>, 2023.
- [23] European Union. Regulation (eu) 2023/2631 of the european parliament and of the council of 22 november 2023 on european green bonds and optional disclosures for bonds marketed as environmentally sustainable and for sustainability-linked bonds. [https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L\\_202302631](https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:L_202302631), 2023.
- [24] Caroline Flammer. CORPORATE GREEN BONDS. *GLOBAL ECONOMIC GOVERNANCE INITIATIVE*, Boston University, 2018.
- [25] GBP SBP Databases and Indices Working Group. Summary of green – social - sustainable fixed income indices providers. [https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/June-2018/2018\\_Green%20and%20Social%20Bond%20Indices%20140618.pdf](https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/June-2018/2018_Green%20and%20Social%20Bond%20Indices%20140618.pdf), 2018.
- [26] Britta Hachenberg and Dirk Schiereck. Are green bonds priced differently from conventional bonds? *Journal of Asset Management*, 19(6):371–383, October 2018.
- [27] Suk Hyun, Donghyun Park, and Shu Tian. The price of going green: the role of greenness in green bond markets. *Accounting & Finance*, 60(1):73–95, March 2020.
- [28] ICE Index Platform. Ice bofa green bond index. [https://www.ice.com/publicdocs/Green\\_Bond\\_Index.pdf](https://www.ice.com/publicdocs/Green_Bond_Index.pdf), 2024.

- [29] ICMA. Green bond principles, 2015, voluntary process guidelines for issuing green bonds. <https://www.icmagroup.org/assets/documents/Regulatory/Green-Bonds/Green-Bond-Principles-March-2015.pdf>, 2015.
- [30] Moritz Immel, Britta Hachenberg, Florian Kiesel, and Dirk Schiereck. Green bonds: shades of green and brown. *Journal of Asset Management*, 22(2):96–109, March 2021.
- [31] Ryan Jones, Tom Baker, Katherine Huet, Laurence Murphy, and Nick Lewis. Treating ecological deficit with debt: The practical and political concerns with green bonds. *Geoforum*, 114:49–58, August 2020.
- [32] Christopher Scheins Christian Schlag Julian Kaupran, Carmelo Latino. (in)-credibly green: Which bonds trade at a green bond premium? *Proceedings of Paris December 2019 Finance Meeting EUROFIDAI - ESSEC*, 2021.
- [33] Cong Ma, Wim Schoutens, Jan Beirlant, Jan De Spiegeleer, Stephan Höcht, and Robert Van Kleeck. Are green bonds different from ordinary bonds? A statistical and quantitative point of view. *National Bank of Belgium Working Paper*, 2020.
- [34] S. MacAskill, E. Roca, B. Liu, R.A. Stewart, and O. Sahin. Is there a green premium in the green bond market? Systematic literature review revealing premium determinants. *Journal of Cleaner Production*, 280:124491, January 2021.
- [35] Muhammad Abubakr Naeem, Saqib Farid, Román Ferrer, and Syed Jawad Hussain Shahzad. Comparative efficiency of green and conventional bonds pre- and during COVID-19: An asymmetric multifractal detrended fluctuation analysis. *Energy Policy*, 153:112285, June 2021.
- [36] Neeraj Chouhan, Caroline Harrison, Deepak Sharma. Sustainable debt global state of the market 2023. [https://www.climatebonds.net/files/reports/cbi\\_sotm23.pdf](https://www.climatebonds.net/files/reports/cbi_sotm23.pdf), 2024.
- [37] Norton Rose Fulbright. Green bonds. <https://www.nortonrosefulbright.com/en-it/knowledge/publications/2df0ab1d/green-bonds>, 2018.
- [38] Juan C. Reboredo. Green bond and financial markets: Co-movement, diversification and price spillover effects. *Energy Economics*, 74:38–50, August 2018.
- [39] Xianwang Shi, Jianteng Ma, Anxuan Jiang, Shuang Wei, and Leilei Yue. Green bonds: Green investments or greenwashing? *International Review of Financial Analysis*, 90:102850, November 2023.
- [40] Nagihan Simeth. The value of external reviews in the secondary green bond market. *Finance Research Letters*, 46:102306, May 2022.
- [41] Standard and Poor Dow Jones Indices. What is an index. <https://www.spglobal.com/spdji/en/research-insights/index-literacy/what-is-an-index/>, 2023.
- [42] Dragon Yongjun Tang and Yupu Zhang. Do shareholders benefit from green bonds? *Journal of Corporate Finance*, 61:101427, April 2020.
- [43] Technical Expert Group on Sustainable Finance (TEG). Report on eu gb standard. [https://finance.ec.europa.eu/system/files/2019-06/190618-sustainable-finance-teg-report-green-bond-standard\\_en.pdf](https://finance.ec.europa.eu/system/files/2019-06/190618-sustainable-finance-teg-report-green-bond-standard_en.pdf), 2019.

- [44] United Nations. Adoption of the paris agreement. [https://unfccc.int/sites/default/files/english\\_paris\\_agreement.pdf](https://unfccc.int/sites/default/files/english_paris_agreement.pdf), 2015. Documento delle Nazioni Unite.
- [45] Olivier David Zerbib. Is There a Green Bond Premium? The yield differential between green and conventional bonds. *Journal of Banking and Finance*, 2018.
- [46] Duygu Zirek and Omer Unsal. Green bonds: Do investor benefit from third-party certification? *Global Finance Journal*, 2023.