

Making Green Bonds Greener: Proposals to Increase the Efficiency of Green Bonds

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Abstract

The Paris Climate Agreement requires tremendous investments into a radically new energy supply, into buildings, transport, mobility and climate-resilience. It was estimated that between USD 5 and 7 trillion of public and private capital would have to be raised each year between now and 2050. Green Bonds are hoped to become one of the main financial vehicles to generate this amount of capital. The Green Bond market, so far, has not been able to stimulate additional green investments. To change this pattern, this paper presents several proposals. The most important one is to implement a disagio in the repayment of the principal if the investment has led to a reduction in greenhouse gas emissions. The value of this reduction would be determined by the market prices for emission certificates. With this mechanism an existing market for certificates could be easily exported into countries that do not have such a market. High multiplier effects from climate mitigation investments could be expected so that these disagio payments would finance themselves. Other important proposals are a support for asset-backed and covered bonds, a credible third-party certification of the greenness of a bond and a clarification of the criteria to determine a Green Bond.

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1. Introduction

According to the December 2015 Paris Climate Agreement, 195 nations committed themselves to prevent global temperatures from rising more than 2 degrees Celsius compared to pre-industrial levels and to try to limit the increase to 1.5 degrees by avoiding greenhouse gas emissions. The signing countries were responsible for roughly 96% of global CO₂ emissions [44]. The Paris agreement represents the first concrete global effort to mitigate climate change. Each country has agreed to publish plans and to report on their progress with respect to their nationally determined contributions (NDCs). To achieve the goals of the Paris agreement, the NDCs will be assessed and adjusted every 5 years [12]. This will force governments to transform their economies and will require an extraordinary amount of financial resources to finance major investments into new technologies and infrastructure, to increase the share of renewable energies and to provide sufficient storage capacities. The mobility, transport and building sector will have to modify to reduce their energy consumption. Many economic sectors will be affected in a fundamental manner [44]. Furthermore, climate-resilient investments will be required so that governments can adapt to the consequences of climate change. According to UNCTAD it will cost between USD 5 and 7 trillion per year between now and 2050 for countries to fulfil their NDCs and IRENA estimates that energy investments will need to increase to a cumulative USD 110 trillion over the 2016-2050 period [25]. Climate financing in 2018 surpassed the USD half-trillion mark for the first time to USD 546 billion [22]. This is still far behind what is needed, according to the estimates. On balance, it is clear that an enormous boost in funding and investing will be necessary to mitigate climate change and its consequences.

The generation of capital required to reduce greenhouse gas emissions in line with the Paris agreement and to build a climate-resilient infrastructure will overextend public budgets by far [14]. It will be extremely important to activate sources of private capital to finance the low-carbon transmission of the economy [22], [12]. Bond markets may play a key role in this regard and Green Bonds may be the most appropriate financial instrument to encourage global private and public investments in this respect as they allow investors to control their investments with respect to their environmental effects. Many investors are eager to make sustainable investments. The Climate Bond Initiative (CBI) claimed that investors with at least US\$45 trillion of assets under management have committed to finance climate-related and other responsible investments [6]. Since the European Investment Bank (EIB) issued the first Green Bond in 2007, the Green Bond market has grown quickly and the variety of bond types has increased to meet the needs of investors. Green Bonds have been issued in over 30 countries [18]. The global Green Bond market potential was estimated to be in the range of US\$4.7 trillion to US\$5.6 trillion of outstanding bonds by 2035. This would be equivalent of an issuance of US\$620 billion to US\$720 billion per year and comprise about 4% of the current debt securities market. In 2020, the cumulative issue volume on the Green Bond market surpassed USD 1 trillion and the yearly issuance has reached a record level

of USD 270 billion - roughly 3.5% of the total global volume despite some adverse conditions caused by the pandemic. This growth in Green Bond issuance was not limited to industrialized countries but was also seen in more advanced developing countries such as China, India, and certain Latin American countries [25]. Most Green Bonds have been issued to finance renewable energy projects, energy efficient buildings, clean transport and sustainable water management projects [2]. If the goals of the Paris climate agreement are to be achieved, it is clear that a rapid growth of the Green Bond market will be necessary.

Up to now, the Green Bond market was not able to stimulate additional green investments [35], [15]. The major aim of this paper is to present several proposals to change this pattern. The most important one is to implement a disagio in the repayment of the principal if the investment has led to a reduction in greenhouse gas emissions. The value of this reduction would be determined by the market prices for emission certificates. With this mechanism an existing market for certificates could be easily exported into countries that do not have such a market. High multiplier effects from climate mitigation investments could be expected so that these disagio payments would finance themselves. Other important proposals are a support for asset-backed and covered bonds, a credible third-party certification of the greenness of a bond and a clarification of the criteria to determine a Green Bond.

2. The Role of Green Bonds

2.1 Characteristics of Green Bonds

The concept “Green Bond” is not strictly defined. One common definition is that a Green Bond is a fixed-income instrument used to finance environmental and sustainable investment projects. Their proceeds are used exclusively to finance green projects that typically have undergone a strong project evaluation and selection process. For the investor, this means both ecological and economic criteria are seriously considered when selecting and evaluating the assets to be financed [13], [22], [23]. Acceptable uses of funds include renewable energy, energy smart technologies, green infrastructure, clean transportation, sustainable water management, sustainable agriculture and forestry, pollution control, biodiversity conservation, climate change adaptation, and eco-efficient products [2]. There are both public and private Green Bond issuers. Public issuers include sovereigns as well as subnational governmental entities, such as states or municipalities, their non-profit corporations, and national public banks. Multilateral development banks such as the European Investment Bank or the World Bank also regularly issue Green Bonds. Common private issuers include commercial banks, mortgage banks and private companies [40].

One of the main aims of the launch of Green Bonds was to reduce financial costs for green projects, because a growing number of investors would be willing to pay a premium to invest in environmental activities [2].

The Green Bond market segment offers different types of Green Bonds, such as:

- Supranational, sovereign and agency bonds which are issued by supranational organizations, governments or development agencies.
- Corporate bonds which are issued by a corporation and backed by a corporate's balance sheet.
- Green financial bonds, issued by financial institutions.
- Municipal bonds.
- Project bonds, which are backed by a single or multiple projects asset-backed securities (ABS), which are collateralized by a bunch of green projects with repayment primarily tied to the cash flows of these projects.
- Covered bonds, which have a claim against the issuer and the pool of underlying assets.
- Revenue Green Bonds, which have bond payments tied to sales generated from green projects, fees or taxes.

In the case of ABS, the investment risk and the claims depend solely on the cash flows from the underlying assets (e.g. windpower plants). Pools of mortgage loans financing green properties could be an important underlying for these kinds of bonds. So far, however, the portion of such bonds in the Green Bond market segment is still very small [40]. Covered bonds usually have a lower risk profile and superior credit ratings. This leads to smaller risk premiums and lowers the funding costs for the issuers. The reduction in the risk premium is a direct function of the perceived quality of the collateral pool.

The need for common definitions what classifies a Green Bond has been addressed by governments or supranational organisations such as the UN who provide a framework to help investors assess whether investments are compatible with the aims of the Paris treaty [41]. The EU has released a taxonomy for this purpose as discussed below in this chapter. The Green Bond market will only have the transparency necessary to realize its full growth potential if Green Bond criteria are sufficiently restrictive and subject to independent external review [20]. If this is not the case, reputational risks for issuers and investors will remain high, reducing their willingness to fund and invest [4]. The issuance of Green Bonds is still a weakly regulated process, with issuers and countries left to decide its own criteria to determine when a bond can be considered as green and how this has to be reported [27]. Nevertheless, there are some guidelines and specifications available to support a Green Bond market. The International Capital Markets Association has propagated the Green Bond Principles (GBP) [23], which for now have become the primary standard assessing Green Bonds. The GBP are often connected with the Climate Bonds Standard (CBS). The CBS contains more detailed criteria and requirements on what is green in accordance with the Paris agreement as well as on the management of proceeds and reporting [37]. The European Commission proposed EU Green Bond Standards, which have the potential to become an internationally recognized guideline. In setting and applying standards, it is important to distinguish Green Bonds from other instruments, such as transition

bonds and sustainability-linked instruments, to avoid confusion. The GBP specifies that all green projects must have a clear environmental benefit, which will have to be measured by the issuer if possible. Projects include clean energy, energy efficiency, low carbon transport, smart grid, and agriculture and forestry. According to the GBP, issuers should transparently inform investors about the environmental objectives of the financed projects and whether the projects belong to the mentioned categories. The issuer should also transparently audit how the proceeds are managed, including tracking, verification and an annual reporting on the use of the funds. The GBP further suggests that issuers should be prepared to provide a detailed report of all Green Bond proceeds, current projects, and anticipated impacts [23]. In practice, however, a relatively high percentage of green debt has not been labelled under the GBP, and many projects have not been provided such disclosure [13].

The Climate Bonds Initiative (CBI) is an international charitable trust focused on investors. The Climate Bond Initiative has released the Climate Bonds Standard (CBS) to help investors and governments classify and prioritize investments that address climate change. Thereby the CBS translates the Green Bond Principles into a concrete applicable standard. For example, CBI' labelled bonds have at least 95% of proceeds dedicated to green assets, and must disclose specified information about the projects they finance [8]. The CBS is divided into pre- and post-issuance processes - the latter of which includes significant disclosure of information with respect to the effective use of the funds for the claimed environmental projects [14]. The CBI has announced that it intends to apply the taxonomy of the EU Commission in the CBS once it has been finalized [37]. The European Union is seeking to align the European financial system with its Green Deal goals [12]. In this respect, the EU Technical Expert Group (TEG) on Sustainable Finance published a Green Bond Standard in 2019 that includes a definition of Green Bonds.

A bond can be classified in this EU-taxonomy as 'green' if the financed activity satisfies the following sustainability criteria [16]:

1. It contributes substantially to at least one of the six specified environmental objectives such as climate change mitigation, climate change adaption, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and finally the protection and restoration of biodiversity and ecosystems.
2. It does not significantly harm any of the other five ('do-no-significant-harm-principle').
3. It complies with minimum social safeguards, mainly in terms of fundamental labour rights.
4. It meets the technical screening criteria adopted by the Commission for each objective.

The EU's definitions of green finance are partially more ambitious than the GBP categories with respect to the aim of a circular economy and wants to reduce waste incineration. On the other hand, the taxonomy also regards investments into atomic power plants and gas as green under certain conditions and for a transitory period. The GBP allows waste incineration for the purpose of electricity generation and does not address the circular economy. The EU also excludes environmentally harmful activities such as the waste of resources and the use of certain chemicals, whereas the GBP does not. Furthermore, to be regarded as sustainable, projects must meet social criteria, such as the eight core labour standards of the International Labour Organization-ILO, which include labour union freedom, and the prohibition of child and forced labour, as well as discrimination [40]. Any Green Bond issuer will have to fulfil these EU-Green Bond Standards as confirmed by an accredited external verifier. The Commission is expected to put forward a legislative proposal for the EUGBS based on the TEG draft in 2021 [20]. While the EU standards will remain voluntary once they are adopted, they are likely to become a de facto requirement for issuers in the European market [15]. The roll out of the EU Sustainable Finance Taxonomy is expected by some observers to give a boost to the development of the Green Bond market [22].

Several third-party agents offer certification services to examine an issuer's ESG² risks if they want to launch Green Bonds. Auditing firms typically provide such third-party assessments. Their access to information enables them to audit the use of proceeds, the compliance with reporting obligations, and in some cases they can measure the environmental impact [14]. Rating agencies such as Moody's or Standard & Poor's have developed criteria to assess the alignment of investment projects with the GBP [41]. Other often mentioned verifiers who have developed their own assessment frameworks include CICERO, the Global Infrastructure Basel (GIB) Foundation, Sustainalytics, and Trucost. Sustainalytics, for example, has developed a quantitative score to measure how well issuers manage ESG issues [27], [25]. For corporate issuances, the assessment of a third party is of particular importance as corporations lack credibility with respect to green investments. Investors are more likely to be willing to pay a premium for a corporate Green Bond if it was certified by a third party [1].

Apart from the GBP, GBI, GBS, the EU taxonomy on sustainable finance and third-party assessments, many national and regional jurisdictions have developed their own national green instrument taxonomies such as the Association of Southeast Asian Nations (ASEAN), the UN Principles for Responsible Investment (PRI), and the countries Brazil, China, India, Japan, and Morocco [33]. The UNFCCC, an international environmental agreement to avoid a dangerous distortion of the global climate system initiated by the UN and the Green Climate Fund (GCF) also have their own standards about what can be defined as a climate-friendly project [19]. In other words, the regulation of what 'Green Bond' means is very much a work in progress.

² ESG = Environment, Social, Governance

Many exchanges have launched specific segments exclusively for Green Bonds, which has improved the liquidity and transparency of the Green Bond market. Bonds listed in these segments usually have to meet the presented standards (e.g., the GBP, CBS, the EU taxonomy on sustainable finance). Interestingly, the London Stock Exchange tightened its Green Bonds listing standards by imposing obligatory reporting requirements for issuers after the launch of the bond [32]. In chapter 3 it will be further analysed why post-issuance reporting may be of particular importance in the effort to improve the effectiveness of Green Bonds. Recognized Green Bond indices have been developed by index providers such as the S&P Green Bond Index or the Barclays MSCI Green Bond Index. The introduction of such indices is an important driver of institutional investor interest in the Green Bond market, because the indices help institutional investors to define their investment universe and risk measurement.

2.2 Advantages of Green Bonds

The cash flow structure of bonds, characterized by high initial investment expenses and long-term cash payments, is well-aligned with the long-term nature of climate mitigation and adaptation projects [18], [40]. Institutional investors, such as insurance companies, pension and endowment funds commonly seek long-term and low-risk investment opportunities. Green Bonds offer these qualities as they generally have long dated maturities and are often rated “investment-grade”. In addition, institutional investors are searching for sustainable investments, so a meaningful demand for Green Bonds can be reasonably assumed [29]. Institutional investors will be of key importance as they are estimated to have more than US \$100 trillion under management [43]. The Green Bond investor base has grown significantly so that institutional investors, corporate and bank treasuries as well as retail investors participate in this market segment [13]. The broadened investor base allows issuers to diversify funding risk and possibly improving funding conditions. A larger base of investors may also attract long-term lenders and thus generate bonds with longer maturities [17], [13]. Ideally, Green Bonds can stimulate green investments by reducing the cost of capital for green projects as investors are willing to pay for the reputation associated with green investments and to act in a socially responsible manner. Evidence, however, suggests that this green premium has not yet materialized in a distinct way [41], [29], [36]. From an investor’s point of view, Green Bonds are generally less volatile thanks to the dominant long-term investment preference of institutional investors who often hold bonds until their end of maturity [39]. In addition, Green Bonds offer greater transparency about the “greenness” of investments allowing investors to reduce search and transaction costs [5].

2.3 Weaknesses of Green Bonds

Green Bonds have the potential to become a key instrument of climate finance as bonds constitute the largest asset class in the financial system. However, the global amount of outstanding bonds sum up to USD 23 trillion, of which Green Bonds constitute less than 1%. This is a disappointing result, although the Green Bond market has grown quickly since its beginning in 2007 [12].

ECB-President Christine Lagarde got to the heart of the matter: “Green assets, while rapidly developing, are still a relatively limited asset class and a taxonomy of what constitutes a green asset is still in its infancy.” She made this statement when the ECB was considering adding Green Bonds to the quantitative easing program [13]. In addition, global development of the Green Bond market has been uneven, concentrated in a few issuing countries and sectors. As of 2019, the USA, China and France were the countries with the highest Green Bond issuance volumes, followed by Germany, the Netherlands, Sweden and Japan [9]. The obstacles to more accelerated development of the Green Bond market will be discussed in the following paragraphs.

Green Bonds have been accused of lacking transparency and credibility. One important reason is that so far, there is no single universally-recognized definition to assess the green status of a bond, as discussed in the previous chapter. All of the existing guidelines are voluntary, and some are so broadly defined that it is difficult to discern a common understanding of what constitutes a Green Bond. For this reason, investors are afraid of “greenwashing” and misleading investments [37]. A key question for investors in Green Bonds is how to verify that the promised environmental benefits are truly delivered. Furthermore, investors may mistakenly assume that Green Bond issuers by definition have low or decreasing carbon emissions. However, that is not necessarily true, because Green Bonds may finance single green projects, while the issuer’s overall emissions increase [15]. It has been found that more than half of Green Bond issuers provided no or only partial disclosures regarding their projects. In Brazil, rain forest replacing eucalyptus plantations were financed with Green Bonds. The Development Bank of Japan provided environmental loans (refinanced by Green Bonds) to companies in the chemical and steel industry without being able to assess the exact use of funds. New buildings, which did not meet the highest climate standards, had been made possible by issuing Green Bonds. Green Bond-financed hydropower plants produce renewable energy, but have caused large-scale destruction of primary forests [40]. It is no wonder several studies have stressed that there is a critical need to reinforce confidence in the environmental integrity of Green Bonds [41].

So far, the Green Bond market has been unable to leverage a meaningful reduction in the cost of capital or other improvements of financial terms to stimulate an increase in green investments. A study by David Zerbib [45] compared Green Bonds with comparable conventional bonds, and found that Green Bonds were on average two basis points cheaper for issuers. This yield effect was somewhat larger for riskier Green Bonds with a financial rating below AAA and a smaller issue size. On

balance, this study does not support the idea that Green Bonds have helped to generate additional capital for environmental projects through lower capital costs. Another study of Gianfrate and Perri [18], showed more hopeful results, finding that senior euro-denominated Green Bonds of various kinds, including corporate, sovereign, agency, municipal, supranational, and financial bonds as well as covered and callable bonds were issued with a statistically significant average negative premium of around 18 basis points. The premium persisted in the secondary market. In another study, the CBI [7] did a comparative analysis on the issue prices of U.S. dollar- and euro-denominated Green Bonds with conventional bonds in the primary markets, and did not find a significant “green premium”. However, as compared to conventional bonds, Green Bonds showed a larger oversubscription. Kapraun et al. [27], investigated over 1,500 Green and 200,000 conventional bonds and came to the conclusion that Green Bonds traded at significantly lower yields of around 18 bps. This Green premium, however, varied largely across currencies and issuer types, and was limited in most cases to bonds which were issued by governments or supranational entities, and denominated in EUR or USD. Corporate bonds, particularly those of smaller companies and bonds in Emerging Markets were not priced with a premium. The authors theorized that Green Bonds issued by governments and supranational entities tend to have larger issue sizes, and might be viewed as more credible in terms of implementation, documentation and impact. In another study, Baker et al. [2], calculated that, assuming holding characteristics and the state of the yield and credit curves to be equal, Green Bonds were issued at a discount of around five to seven basis points lower than those of ordinary bonds. However, if Green Bonds were CBI-certified, then the premium increased to 26 basis points. Studies from Karpf and Mandel [28], Hachenberg and Schiereck [21], Larcker and Watts [31], and Bachelet et al. [1], did not support the existence of a green premium. On balance, the evidence for the existence of a premium for Green Bonds in either the primary or secondary markets was mixed. One cannot assume that investors have been willing to pay a significant premium for an environmentally sound investment, as of yet. It appears that investors have only been willing to offer a significant green discount for bonds, which have had the benefit of an external, recognized certification of their status. If the additional costs needed to receive a green certification were compared with the premium offered by investors, Green Bonds seem to be slightly beneficial for their issuers, on average. The empirical evidence appears to support the perception that Green Bonds offer at best a little financial incentive to issuers up to now.

Probably the most serious criticism of Green Bonds is that their underlying projects were likely to have materialized whether the bond issued to finance them was labelled as ‘green’ or not [35], [41]. Also, Ehlers et al. [15], found little evidence that previous Green Bond issuances led to any decarbonisation of companies. Even if bond proceeds moved into green projects (e.g. renewable energy), issuers were often heavily invested in carbon-intensive activities elsewhere such as coal power plants [40]. This is not surprising as the majority of companies with very high carbon intensities are power producers, which also invest in renewable energies.

The good news is that this pattern has begun to change as renewable energies have become significantly more cost-competitive over the past years and investments in them have surpassed investments in carbon-emitting power plants by a wide margin. Other positive news is that in other sectors with typically higher carbon intensities, such as industrials and real estate, Green Bond issuers appear to have achieved lower carbon emissions than firms that did not issue Green Bonds [15]. Apart from this good news, severe problems remain. Green Bonds have not been sufficiently diverse. Most Green Bonds have been issued by large debtors with high credit ratings and ready access to the regular bond market [15]. Green Bonds from these issuers just replace conventional bonds without stimulating additional investments in green projects. Their impact on climate mitigation or the environment in general is rather small [41]. Green Bonds do not appear to be well suited to finance investments that pose high financial risk, such as those involving expensive or risky technologies, or in countries with a low credit rating, as the number of Green Bond issuances in such cases is disproportionately low. In countries with a credit rating between C and D, the share of Green Bond funds as a percentage of all private debt instruments is 0.11%, less than half that of AA to B-rated countries [40].

In addition to the obstacles described above that hinder Green Bonds from becoming the financial accelerator for climate mitigation, there are hurdles from the investors' and issuer's perspectives as well. First of all, Green Bond issuance is associated with higher costs and complex processes. It is commonly necessary to engage third-party service providers to assist with onerous documentation requirements and the external evaluation of a Green Bond, which causes additional costs. Moreover, issuers must comply with control and reporting requirements over the entire term of the financed project. Commonly accepted standards for the definition of a Green Bond, its certification and monitoring may help to reduce these costs in the future [4]. Green Bonds may also raise reputational and legal risks for an issuer that fails to meet the green standards. The problem here is that it may not be completely under the control of the issuer whether the aims of a project do materialize. Expectations may have been overly optimistic, technical problems may occur or the market changes may force the company to adjust the production process, causing higher emissions. An issuance that does not fulfil expectations may provoke strong reactions in the Green Bond community and harm future projects of the issuer [41]. Investors have to face specific challenges with Green Bonds as well. Compared to conventional bonds, the investor has to conduct additional due diligence for Green Bonds to make sure that a Green Bond is truly green. If information on the underlying projects is not standardised, or if there are competing Green Bond standards, the investor has to do a lot of research in order to receive the relevant information before an investment decision can be made [12]. Once a Green Bond has been purchased, the investor has to monitor the financed green projects. At the beginning of a project, investors can only rely on the expected impact of the green project. Commonly agreed Green Bond standards would help investors to evaluate the greenness of the bond. The still existing shortcomings of standardization remain an important obstacle for all market participants. This is

particularly true for the risk that the issuer of a Green Bond is non-compliant with recognized standards. Institutional investors and their clients may react very negatively to such events if they become public in the media [12]. According to KPMG [30] the major misconducts in this respect are:

- Proceeds are used to fund activities that are not considered green.
- Core business activities are seen as unsustainable.
- Use of proceeds are not tracked properly and not reported in a transparent manner.
- There is insufficient evidence that projects have contributed to a better environment.

If the Green Bond market does not offer sufficient environmental integrity, it could be harmed and its growth limited as a result.

Another problem for institutional investors is that the Green Bond market is still relatively young, and it offers neither the level of reputation nor the inventory that these investors are expecting. In addition, the Green Bond market segment does not offer sufficient historical data to develop and conduct a proper risk management for these bonds. This hurdle may fade over time but is still a restricting factor for funds in these days.

Finally, a fundamental impediment that prevents more private finance of Green Bonds is the mismatch in project size between the needs of investors and green project developers. Green Bonds are most suited for large projects with long investment horizons and relatively low technology risk. These characteristics are often absent in the case of corporate bonds, as the green projects of corporations are commonly not large enough for bond issues (i.e., those that raise USD 200 million or more). Emerging markets still struggle to raise funds internationally because investments in these countries are often riskier than institutional investors are willing to accept, as previously analysed. This is particularly problematic when they do not have sufficiently developed financial markets with long-term debt instruments [14].

After all, issuers repeatedly emphasize that although the financial benefit of issuing a Green Bond is limited, a broadening of their investor base could be a significant benefit. The issuance of a Green Bond may help the issuer to gain the attention of sustainable investors. Sustainable investors are also seen as long-term oriented, which makes them attractive to issuers [41]. Another glimpse of hope begins with a negative aspect that later may turn into a positive one. The issuance of a Green Bond is accompanied by extensive documentation. Issuers can gain a comprehensive learning experience once they have mastered the launch of a Green Bond. This learning experience can have a direct impact on the willingness to finance further green projects. This also may work for banks as green lenders and their willingness to lend [40].

3. Proposals for more efficient Green Bonds

3.1 A disagio as a reward for truly sustainable investments

The purpose of Green Bonds to support the transition towards low-carbon economies depends on a noticeable financial benefit for the issuer in terms of a Green premium. In addition, sustainable investors should trust that their investment in a Green Bond really helps to reduce carbon emissions or stops climate change in one or the other way. As the literature review in the chapter about the weaknesses of Green Bonds has shown, such a Green premium is currently quite small or only to be observed for a limited spectrum of Green Bonds. How big does a Green premium need to be to make a Green Bond favourable for an issuer? The Green premium would need to be at least as large as the additional costs of launching a Green Bond in comparison of a conventional bond. Estimates for upfront and permanent costs of a Green Bond, such as the costs of complying with labelling, certification, reporting, verification and monitoring requirements, depend on the market, the type of bond and other specifics of the transaction. The costs associated with a green certification under the GBP, the standard followed by many issuers in the Green Bond market, range from US\$15,000 to US\$20,000 [29], [2], [26]. The OECD estimates that second-opinion verification of procedures and reports by an authorized third party can cost between US\$10,000 and US\$100,000. If one assumes complete costs to be US\$100,000 and an issue volume of US\$ 500 Mio., the costs would 0.02%, or 2 basis points. In other words, even a Green premium that is quite small would generally be sufficient to cover the additional transaction costs of a Green Bond. Considering the overall costs and cash flows of an environmental investment financed by a Green Bond, it becomes clear that extra transaction costs of a Green Bond and the potential Green premium just play a minor role. More important than this premium are the incoming cash flows of the project and the discount rate of these cash flows. The cash flows may be impacted by three factors:

1. The revenues that result from selling a good to the market (e.g. electricity).
2. The savings that are generated once the project is complete as a result of higher efficiency (less consumption of electricity per produced unit).
3. The savings of not being forced to buy emissions rights in case that a market for emission rights has been established by the local government.

The discount rate will be determined by the duration of the bond, the credit quality of the issuer, the liquidity of the bond, which is to a large degree dependent on the issue size - and the Green premium. For the success of Green Bonds two factors will be particularly vital:

The existence of sufficient profitable Green projects and the existence of a market for emission rights on which the price for emissions reflects their true environmental costs.

The importance of the emission market can be assessed by the following example: Electricité de France (EDF) issued a Green Bond in October 2016. The issue volume was 1.75 bn. euros, and the maturity 10 years. The funds were used for new wind-, solar- and hydro power plants. It was assumed that the funds raised by the Green Bond issuance would finance 65% of the new energy production capacities, which would lead to a CO₂ emission reduction of 1.4 megatons. In the current European emission market, one ton is traded at roughly 50 euros. This would lead to a yearly expense reduction for EDF of 45.5 Mio. €. The coupon was 1% so yearly coupon payments were 17.5 Mio. * 0.65 = 11.38 Mio. €. Thus, the interest costs plus more than 30% of the investment expense could have been covered by the reduction in emission costs in this example. In addition, of course, there are the revenues for selling the produced electricity to the market. Furthermore, the share of the cost of capital in the total costs for renewable electricity plants is estimated to be as high as 50-70%. Even relatively small changes in the cost of capital could therefore play a significant role in facilitating project development. The existence of emission rights would reduce the investment risk considerably, so a decline in the risk premium and the cost of capital could be expected. In summary, a market for CO₂ emissions is a key driver for Green Bonds, and has the potential to bring them to a level where they can truly lead to the urgently needed reduction in CO₂ emissions.

Where a market for emission rights does not exist, an alternative mechanism can be introduced:

Once the Green Bond matures, the true reduction in CO₂ emission of the financed projects would be assessed and valued by the price for emission rights of a reference market, for example the European market for emission rights. This value would be returned to the issuer in form of a disagio by an environmental sponsor. In the previous calculation example for the EDF-bond the disagio would have had a size of the mentioned 45.5 Mio. €, which would allow the issuer to finance four of the ten yearly coupon payments. The incentive to finance and initiate green projects would increase significantly. Depending on the country or sector, an environmental sponsor could be a local government, a development bank, or a transfer of industrialized countries to issuers in developing countries in line with the Paris agreement. The proposal to link Green Bonds with such a disagio is supported by the fact that carbon emissions can be in large part verified by improved data and disclosure which have become available for most big corporations in many countries [15]. Third parties, such as academic institutions or rating agencies, have developed approaches to assess firms' carbon emissions. In some jurisdictions (e.g. the United Kingdom), disclosure of carbon emissions is even mandatory for most large firms. It is important that the assessment is made on a firm-wide-level rather than on the basis of individual projects, and it should capture a company's entire value chain. Otherwise, companies could simply reduce their emissions by outsourcing carbon-intensive activities, or invest in environmental friendly projects using Green Bonds, while at the same time financing emission-intensive projects by issuing conventional bonds [15]. The benefit of this proposal is not only to accelerate investments in projects that reduce greenhouse gas emissions but the

local government could also expect to see a multiplier effect with respect to economic activity and governmental tax income. In a study made by Pollitt [38] for the EU Commission, it was found that for financial green investment support schemes by governments in years after the financial crisis of 2008, the measured multiplier for the EU as a whole was 1.5. The effect was found to be particularly high if the goods and services for the green projects were locally made and – even more important – if public financial support attracted private capital. The latter effect can be achieved if the Green Bonds become equipped with the described disagio as the local government has only to finance the disagio but all other capital of the bond can be raised in financial markets. Just for this reason, one can reasonably expect that for Green Bonds with such a disagio structure the economic multiplier would become larger, as in the study. Furthermore, the study of Pollitt only assessed short-term effects and the expenditures at the time were mostly aimed to support short-term consumption, such as the scrapping bonuses for cars. If long-term effects were also been considered, and the expenditures were more focussed on infrastructure and (energy) technology, the multiplier effects could become higher. In another study, Deledi et al. [11], found that public investments that attract private capital to a large extent and are able to generate long-term growth expectations and technological progress could stimulate private activity on top of the original project, and thereby create a so-called super-multiplier of 6 to 8 in the longer run on an accumulated basis. This means that one euro of government money could generate 6 to 8 euros of further spending. In this case governmental spending will not only be refinanced but could create additional income for the government. Could one expect this to happen from investments in renewable energy or other projects which lead to a reduction in greenhouse gas emissions? A recent study by Batini et al. [3], estimated the effect on GDP of money spent for green investments. The estimated multipliers had a size of roughly 1.5 for renewable energy investment over a year. However, the accumulated effect over five years was much higher as the size of the multiplier was astonishingly persistent and remained at the level of the first year over the entire period. The accumulated multiplier was about the same size than the mentioned super-multipliers. These results are intuitive for several reasons. Clean energy is labour intensive and wages are above average. Muro et al., [34], found that workers in clean energy earn mean hourly wages that were between 10% and 20% above the national average. Renewable energies can create a safe and sustainable power supply; the value creation remains to a large extent local, creating local jobs and a lot of technological innovation occurs with the implementation of renewable energies. Furthermore, environmentally sustainable investments tend to have larger multipliers and higher job impacts during periods of high uncertainty as it is existent today due to the fact that the entire economy needs to be reconstructed [24]. All this speaks for a scenario in which indeed a kind of super-multiplier seems to be realistic. While one has to assess each investment case individually before one can estimate the likely size of a multiplier, it looks plausible that a similar scenario could prevail also for other green investments than renewable energies. In the case that green projects in developing countries are financed by the disagio, the money

from industrial countries meant to support the transformation process there would be very effectively used. Some of the multiplier effects would still remain with the sponsoring countries through the effects of international trade and the fact that most of the environmental technologies would be developed there. An exact share to what extent the multiplier effects remain in the sponsoring countries is hard to measure. Since the group of industrialized countries have promised in the Paris agreement to transfer 100 billion \$ per year to developing countries this aspect should not play a dominant role. This proposal may become particularly important as emerging and developing markets gain momentum. In 2018 for example, these markets accounted for 63% of all renewable power investments. China, India, Brazil, Mexico, South Africa and Chile were the main destinations for these investments [25].

So far, however, the financial support of development banks looks different. Development banks are currently supporting the issuance of Green Bonds in countries of the Global South, by fully underwriting Green Bond offerings in these countries. For example, the World Bank subsidiary International Finance Corporation is buying Green Bonds in countries such as Morocco, India and Peru [40]. In other arrangements a development bank or the Green Climate Fund (GCF) of the UNFCCC, for example, issues the Green Bond, typically with very low yields due to its strong credit rating, and then the proceeds with their attractive conditions are transferred to environmental projects that are undertaken in partnership with local banks in developing countries. Sometimes the issuance of a Green Bond is linked with financial guarantees by the development bank to reduce the risk for investors in emerging markets [14]. These measures, however, have not been sufficiently effective to stimulate additional green investments as previously stated. A substantial amount of investments that will be required to achieve the national contributions to the global greenhouse gas emission reductions according to the Paris agreement will have to be done at the city or municipal level. The World Bank has estimated that less than 20% of cities in developing countries are sufficiently creditworthy to access the domestic capital market. The described support by the development banks, as well as the proposed disagio for Green may be a solution to this problem, as they make Green Bonds significantly more attractive to international investors and thereby help to generate the urgently needed private capital to finance the transition to a global emission neutral economy.

3.2 ABS and other supportive features

In contrast to classical Green Bonds, asset-backed Green Bonds do appear to have spurred additional investments in green technologies. Asset-backed bonds, which have been guaranteed by development banks, have been particularly effective. As the cash flow duration of renewable energy projects often lasts several years, the credit-providing local banks have to accept that their equity capital will be also blocked for this long time. Banks in the Global South in particular, therefore face tight limits in financing green projects. A green ABS enables the bank to pass on the risk to investors, and to grant new - additional - green loans much faster. This is

the major reason for the effectiveness of Green ABS Bonds in these countries. In addition, packaging debt into different structures allows issuers to align the maturity and credit risk with the preferences of the investors. This feature makes Green ABS Bonds even more attractive. From the issuer's point of view, they have another important advantage. Due to the level of emission costs and to secure its index inclusion it would not make sense to issue a bond of a size of less than USD 300 million. Many companies do not have green investment projects of this size available [10]. This problem can be solved by pooling smaller credits through securitization in the form of asset-backed bonds; this may be particularly useful in the case of (developing) markets, where projects will not typically reach a sufficient size to be financed with single project Green Bonds.

Another promising bond type for the Green Bond market is a covered bond. The usually steady and long-term cash flows of environmental investments make them well-suited assets to be used as collateral. This is for example true for investments in green buildings, renewable energy, sustainable transport and water conservation. The success of covered bonds as a financial vehicle for green investments depends on an appropriate legal framework which is able to guarantee investor claims, provide clear definitions on the characteristics of the assets in the covered credit pool, and force investment banks to select the credits for the covered pool carefully with respect to their credit quality. Governments should support the implementation of such legal frameworks to spur the development of covered bonds although the market segment of covered bonds in the Green Bond market is gaining in importance [29].

As described in chapter 2, the confidence of investors in the Green Bond label has to be improved by aligning Green Bond Standards with the goals of the Paris climate treaty. Whether the new EU taxonomy on Green Bonds can fill this gap remains to be seen. Other important ways to increase the credibility of Green Bonds include external certifications by second parties such as specialized environmental institutes or agencies that offer sustainability ratings. Financial rating agencies such as Moody's and Standard & Poor's have also developed certification systems for Green Bonds. However, some authors believe that it would be better to maintain a separation between credit rating agencies and green rating agencies. On balance, an external assessment is often chosen by issuers to offer investors insight into the ecological quality of their bonds. As data on firms' carbon emissions has become available for the majority of listed firms, a rating's content can be easily verified [12].

4. Conclusions

According to the December 2015 Paris Climate Agreement, 195 nations committed themselves to keep the rise in global temperature below 2 degrees Celsius compared to pre-industrial levels by avoiding greenhouse gas emissions, and to undertake efforts to limit the temperature increase to 1.5 degrees. This aim requires tremendous investments into radically new energy production and storage capacities, but also buildings, transport and mobility have to alter their way and amount of energy consumption. Climate-resilience will have to be improved significantly. To finance these investments, it was estimated that every year between USD 5 and 7 trillion in public and private capital will have to be raised until 2050. Green Bonds are hoped to become the financial vehicle that generates a large portion of this tremendous amount of capital. Despite impressive growth since its introduction in 2007, the Green Bond market has disappointed so far. It has not been able to stimulate additional green investments, but mostly replaced other forms of financial instruments. To change this pattern, this paper advances several proposals to make Green Bonds more effective. The most important proposal was to implement a disagio in the principal repayment if the investment has led to reduction in greenhouse gas emissions. The value of this greenhouse gas emission reduction would be determined by the market price for greenhouse gas certificates, such as the one that exists in the EU. With this mechanism, the EU market for emission certificates can be easily exported into other countries. The disagio could be paid by governments or development banks in case of developing countries. Some studies show that very high multiplier effects from these kinds of investments could be expected, so that they in essence finance themselves. Other important proposals are a support for asset-backed and covered bonds, a credible third-party certification of the greenness of a bond, and a clarification of the criteria to determine a Green Bond to foster the trust of investors in this bond market segment. The widely discussed and analysed premium for Green Bonds does seem to play just a minor role for Green Bonds as an important financial vehicle to finance climate change mitigation, as it does not need to be very large to cover the additional costs linked with the emission of a Green Bond.

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