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Are green bonds a viable way to finance environmental goals? An analysis of chances and risks of green bonds

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Are Green Bonds a Viable Way to Finance Environmental Goals?

An Analysis of Chances and Risks of Green Bonds

Markus Demary / Adriana Neligan

Köln, 20.06.2018

INSTITUT DER DEUTSCHEN WIRTSCHAFT

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JEL-Classification:

E22 - Investment: Capital, Intangible Capital, Capacity
G11 - Portfolio Choice, Investment Decisions
G12 - Asset Pricing, Trading Volume, Bond Interest Rates
O16 - Financial Markets: Saving and Capital Investment, Corporate Finance and Governance
Q01 - Sustainable Development
Q54 - Climate, Natural Disasters and Their Management, Global Warming
Q56 - Environment and Development: Environment and Trade, Sustainability, Environmental Accounts and Accounting, Environmental Equity, Population Growth

Summary

The European Union is currently making significant strides to lead on green finance and align its financial system with its climate, sustainability and clean energy ambitions. The Paris Climate Agreement, the G20 Green Finance Study Group and the G19 Hamburg Climate and Energy Action Plan have provided ongoing momentum for policy moves towards a green financial system. Including financial markets into a climate strategy is a logical step forward, because public funds are insufficient to finance the needed investments in green technology and because the financial sector shows interest in financing green technology.

Given the long-term nature of green investments and the financial market's short-termism, the establishment of a liquid market for green bonds is the market solution to this maturity mismatch. However, for such a market to thrive, investors need a definition of green technology as well as a definition of what a green bond is. In addition to that, green disclosure rules are needed, so that investors can easily access information on how the proceedings of green bonds are invested.

The EU's main efforts in establishing a market for green bonds are the legislation of a common taxonomy for green bonds and the stimulation of the demand for green bonds by a green supporting factor in bank capital regulation. While we agree that a common taxonomy will help investors to screen green projects, we are very sceptical about the green supporting factor, which causes lower equity capital requirements for green investments. We see the risk that this may give rise to an undercapitalisation of banks with respect to the default risks of green projects and an overinvestment of banks into these projects. Since the green bond market is a political project, there is the danger of privileging green bonds in financial regulation for achieving political goals. The emergence of a green bond bubble and the bursting of that bubble would be harmful to the financial sector and it would hinder reaching the climate goals, since investors will abstain from investments in which they have lost money before.

We derive the risk of political interventions to stimulate the demand for green bonds from our estimates, which indicate that annual green bond emissions have to grow by the factor 45 in order to finance the potentially needed overall annual investments of up to USD 7 trillion making a higher indebtedness or significant portfolio shifts necessary. Looking only at incremental investments needs to reach the climate goal green bond issuance would also have to increase up to the factor 4.5 and to reach the Sustainable Development goals by the factor 15.

Instead of pushing for a fast growth of the green bond market, the EU should strive for its organic growth. Therefore, it should rely on market intelligence, i.e. the market participant's risk assessments for the green projects' default risks together with the market participants evaluation of the greenness of green investment projects. To this end, the proposed harmonisation of the taxonomy within the EU is a necessary step, because different national taxonomies would hinder the emergence of cross-border markets for green bonds. The EU cared about the consistency of the green bond proposal with other regulations for financial institutions, but it would be necessary to guarantee consistency also in the future. Otherwise, unintended side effects could distort the investment decisions of financial companies.

1 Introduction

With its EU Action Plan on sustainable finance the European Union currently aims at better aligning the European financial system with its climate, sustainability and clean energy ambitions. Even though financial markets increasingly differentiate between sustainable – or specifically green – and other investments, green financing is only a small market at this point. Yet, it is still unclear, how such investments can become more mainstream without policy distorting investment decisions.

Green bonds are regarded as a key green financial product to raise capital market finance for environmentally-friendly and more sustainable investments. Since the first issuances by the European Development Bank and the World Bank a decade ago, the international green bonds market has grown rapidly. Nonetheless, green bonds still only make up a small part of the overall bond market.

Green bonds are identical to conventional bonds with two exceptions: (1) their proceedings are only allowed to be invested into green projects, and (2) they are more transparent compared to conventional bonds about how the proceedings are invested. We do not assume the green bond investors to be pure philanthropists, but rather assume them to be rational economic actors, who will invest into a green bond, if the risk-adjusted returns are comparable to a conventional bond and there is more transparency in the green bond about how the proceedings are invested. This additional transparency helps the investor to better assess the risks of investing into green technology. Moreover, we assume investors to purchases green bonds, if they benefit from the green label in their image and marketing campaigns. We also assume rationality for the issuer. The issuer will invest in green technology, if he or she benefits from that investment. The issuer will issue a green bond instead of a conventional bond, if he or she can reach a larger investors base with the green bond and when the additional compliance costs of issuing a green bond are lower than the additional benefit from issuing a green bond.

When we discuss green finance, we combine the viewpoints of financial market investors and issuers, i.e. we do not only focus on greening the financial system, but also how the financial system can contribute to greening the economy by financing green projects. While the issuers want to reach financiers for their green projects, the capital market investors also want to contribute to finance green projects, because they know about the long-term risks of climate change to the financial system. The problem the investors face is that the long-term nature of green projects does not coincide with their short-term investment horizons. Aligning the investors' short-term investment horizons to the long-term financing of green projects is in our view possible by a liquid market for green bonds. We see this as the market solution for financing green technology and greening the financial sector.

Therefore, the aim of this report is to analyse how to improve incentives for capital flows towards more sustainable investments while still relying on market intelligence. The focus here lies on how the market for green bonds can be strengthened by looking at its main rationale, definitions and standards. Finally, necessary reforms and measures are discussed in the context of current policy moves. Main questions are:

- Why and how do we need green finance? What are the investment requirements of the future?
- What are adequate policy measures to maintain the privately driven character of the market?
- Which policy measures will undermine the market's selection and monitoring functions?
- Is a common EU Green Bond standard a way to align market actors?

2 The Sustainability Agenda requires investments

2.1 A paradigm shift towards sustainability

Current global issues and challenges such as climate change, biodiversity loss, scarcity of resources, a growing world population, and helping developing countries to tackle their problems call for integrated and problem-solving approaches. In recent decades, rapid economic growth and social progress have been accompanied by increasing environmental pressures and a reduction in natural resources. A relative decoupling of economic growth and resource consumption can be seen especially in the Western industrialised countries, while economic growth of emerging economies has reinforced a high rise in waste generation and resource consumption at the global level. Today, around 7.6 billion people live on earth, with the latest United Nations projections predicting 9.8 billion in 2050 and 11.2 in 2100 (UN, 2017). With a strongly growing world population demand for raw materials will also increase substantially.

Among common global challenges, climate change has far-reaching implications for our society and needs medium- and long-term considerations. Both developed and developing countries play a role in tackling such a challenge. In addition, increasing urbanisation, rising mobility needs and other environmental burdens are further global challenges and need to be countered with economically viable solutions.

Sustainability requires a global paradigm shift. Hence, sustainability is the big issue of our time. Yet, the debate is not new as it has already been going on for decades. In 1987, the Brundtland Commission launched the current debate by defining sustainable development as a 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. Sustainability is seen as a three-pillar concept with an ecological, economic and social dimension that stands side by side on an equal footing (Hauff, 1987). In particular, since the Earth Summit in Rio 25 years ago, a broad and international sustainability debate has taken place.

Today, sustainability in the economic, ecological and social sense is already established as an essential guiding principle for political and economic action and has found its way into international, European and national sustainability strategies. However, in recent years the focus has been mainly on environmental sustainability. This is reflected in ideas such as the concept of a "Green Economy" by the United Nations and the very similar concept of "Green Growth" by the OECD.

In particular, two recent landmark impulses have pushed policies towards a more sustainable, greener and low carbon economic path at a global level:

- The UN Agenda 2030 for Sustainable Development continues to understand sustainable development according to the three-pillar definition by Brundtland. With its 17 Sustainable Development Goals (SDGs) and 169 targets, it is a non-binding approach to sustainable economic, environmental and social development by 2030. It is the first global agreement to have a universal comprehensive action plan involving all countries and stakeholders (governments, civil society, the private sector and science). Although not mandatory, national states are expected to consistently implement them. The 2030 Agenda brings together two previously separate UN negotiating processes, the 1992 Rio Earth Summit Process and the Millennium Development Goals Process, called 'Transformation for Sustainable Development". In particular, the private sector is expected to play a key role in the implementation of the SDGs (Diermeier/Goecke/Neligan, 2017).

- With the signing of the Paris Climate Agreement at COP 21 in December 2015 a landmark agreement was reached to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. 195 countries accounting for 96 percent of global CO_2 emissions signed this legally binding agreement. For the first time, it brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt its effects, with enhanced assistance for developing countries to do so. The central aim is to respond to the treat of climate change by keeping a global temperature rise this century below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. In comparison to the previous 2 degrees Celsius target of the Kyoto protocol this implies a clear tightening of the targets. In addition, each country determines plans and regularly reports its own national climate change efforts in their nationally determined contributions (NDCs). The NDCs are evaluated and adjusted every 5 years to assess the collective progress towards achieving the purpose of the agreement. Finally, commitments were made to finance adaption measures in developing countries. Thus, the agreement represents a progress to protect the climate (Puls/Schaefer, 2016; UNFCC, 2018).

The European Union is also set to move on a more sustainable path. The following policy measures aim to boost climate action according to the Paris Agreement at EU level (also see European Commission 2017b; European Parliament, 2018a):

- With the communication 'The Road from Paris' the European Commission sets out how the EU will implement the Paris Agreement. Besides fulfilling the Energy Union transition goals and multi-stakeholder action by civil society, it sees scaling up private investment and boosting climate-related innovations and competiveness as key measures.

- The 'Clean Energy for All Europeans' legislative package covers mainly energy efficiency, renewable energy, design of the electricity market, security of electricity supply and governance rules for the Energy Union to push the energy transition as a key investment and growth sector of the future and providing a fair deal for European consumers. Further complementary actions are among others to encourage public and private investment and actions to accelerate clean energy innovation.

- Accompanying the communication 'Clean Energy for All Europeans' the European Union updated its EU targets following the 20/20/20 targets of the EU 2020 Climate and Energy Package in 2008. Latter set out fundamental EU-wide targets of 20 percent each on greenhouse gas emissions reductions, the share of renewables in the energy mix, and energy efficiency. This was complemented in 2011 by the 2050 energy roadmap and in 2014 by the 2030 Climate and Energy Framework. The Energy Union Governance process streamlines these targets. Moreover, it associated' reporting requirements with regards to monitoring and reporting progress towards 2030 targets across all areas under the umbrella of the National Energy & Climate Plans.

Until 2030 the European Union aims at achieving following EU climate and energy targets and goals (European Parliament, 2018a; European Parliament, 2018b)(s. Table 2-1):

- The binding target to reduce the overall greenhouse gas emissions by at least 40 percent below 1990 levels by 2030 is split into two sub-targets: the sectors covered by the European Emissions Trading System (ETS), mainly energy-intensive industries and power stations, will have to lower their emissions by 43 percent compared with 2005, while non-ETS sectors (building, agriculture, waste and transport excluding aviation) will have to reduce theirs by 30 percent. For latter the effort sharing legislation sets national targets for each Member State according to national wealth, ranging from 0 to 40 percent below 2005 levels.

- The binding renewable energy target of at least 27 per cent was set in 2014. In a recent EU trilogue negotiation (June 2018) it was decided to increase the share of renewables in final energy consumption to 32 per cent.

- The non-binding energy efficiency target aims for at least 27 percent energy savings compared with the business-as-usual scenario by 2030. However, a higher and binding energy efficiency target is currently under negotiation, but recent talks did not come to a conclusion on this issue.

Table 2-1: Key EU climate and energy targets (2020/2030) and goals (2050)

In percent

EU Level Target	2020	2030	2050 (indicative)	Baseline
Greenhouse gas emissions	20	40	80-95	Reduction compared to 1990 levels
Renewable Energy	20	32*	55	% of total energy consumption
Energy Efficiency	20**	27** (under negotiation: 30-35)	41	Reduction compared with BAU scenario

*binding on EU level, no national targets, new target was decided in Trilogue negotiation on June 14, 2018

**not binding

Source: own compilation based on European Parliament (2018a)

Hence, not only at the global level but also in recent EU policies ambitious energy and climate targets have been set to enhance sustainability.

2.2 Scaling up adequate investments and finance

With the international community pushing sustainability, adequate 'sustainable' investments are needed to achieve the set goals. For example, to enable economic development in line with $C0_2$ reduction and climate resilience, investments in appropriate technologies and infrastructure are necessary. In particular, in the case of energy supply such technologies affect all economic sectors, e.g. private households, buildings, transport and mobility. In addition to financing CO_2-reducing technologies, it is also key to finance climate-resilient investments inducing adaptation to climate change. On the one hand better financing options can result from an enlargement of funds (state-supported but also private initiated) and on the other hand from switching investment activities towards climate-related investments (OECD, 2015). In particular, in the case of energy supply, the latter option seems necessary, as recent developments in prices and market rules neither indicate deviation from fossil energies nor a consequent adaption to climate change.

To adequately finance 'sustainable' investments the current financial system also has to take into account sustainability criteria. Traditional finance only focusses on financial return and risk. Social and environmental externalities are by their nature not incorporated in the decisions taken by companies and investors. As most externalities play out in the medium- to long-term,

the problem is aggravated by the short-term horizon executives and investors work in. In contrast, sustainable finance looks at how finance (investing and lending) interacts with economic, social and environmental issues. While the traditional shareholder model places finance first and has a short-term horizon, the stakeholder approach seeks to balance the financial, social and environmental aspects and is more focused on the long-term (Schoenmaker, 2017).

In the current debate on financing such investments the concepts of sustainable finance, green finance and climate finance are partly used interchangeably. Yet, it is sometimes difficult to draw a line between these concepts. In this report, green finance is understood as a sub-set of sustainable finance and climate finance is a sub-set of green finance. Within the domain of green finance, financing of climate-change mitigation has received international attention (EU Commission, 2017a). Looking at the two international agreements, both only refer to the specific sub-set of climate finance and do not explicitly address the need for sustainable or green finance in a broader sense:

- Since the UN Agenda 2030 for Sustainable Development mainly formulates a wide range of goals with its SDGs, there is no explicit reference to sustainable or green finance. The architecture of financial and non-financial means to implement the 2030 Agenda is, however, provided in the Addis Ababa Action Agenda. Since substantive investments are needed, which cannot be covered only by national and international public funds, the Addis Agenda calls for a stronger involvement of the private sector at national and international levels. Yet, the mobilisation of private capital in line with national priorities for sustainable development is a major challenge in many countries. Governments need to develop appropriate approaches and instruments to incentivise private investments while ensuring that these will also safeguard or promote social, environmental and good governance principles. In addition, the Addis Agenda recognises and supports the work of the United Nations Framework Convention on Climate Change on climate finance but does not address this issue in more detail. Even though it sees a need for public and private investments and clean technologies, the Addis Agenda also emphasises that it cannot be a substitute for efforts to reduce waste or efficiently use natural resources (UN, 2015).

- The Paris Climate Agreement explicitly refers to the need of mobilisation and access to climate finance. It formulates following call for policy makers concerning the financial sector in article 2.1 c): ‘Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development’ (UNFCC, 2015). If public finance flows have to be redirected to low-carbon and climate resilient development, the scale of financing needs also requires a shift in the reallocation of private finance flows from carbon-intensive activities to low carbon ones compatible with the 1.5-2 Celsius degree pathway (I4CE, 2017). As part of the Paris outcome, developed countries were urged to scale up their level of support with a concrete roadmap to achieve the goal of mobilising US$100 billion per year by 2020 for climate action in developing countries (UNFCC, 2016).

Since the current debate on sustainable finance includes a strong green finance component aiming at supporting economic growth while reducing environmental damages, the following sections will focus on green investments and their possible ways of financing.

2.3 Global investment requirements

To deliver on climate and other environmental goals major investments and international solutions for financing these are needed. It involves a transformation of the conventional economy towards efficient, low-carbon products, technologies and services via technical and social innovations and investments. The process of greening, however, takes not only place in the environmental sectors, but extends to all other sectors of an economy.

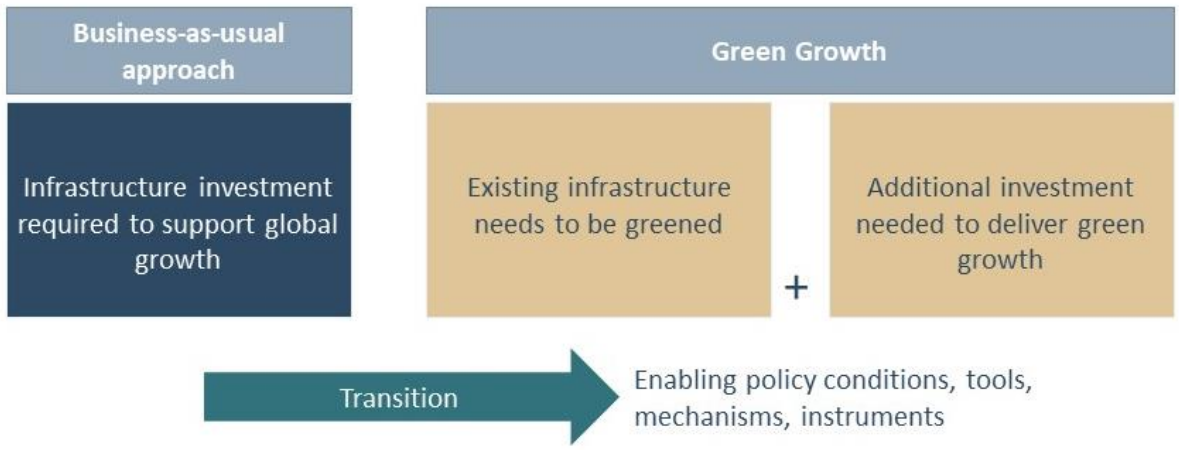
With the Paris Agreement, the global community faces major challenges in mobilising the investments required to meet the shared goal of limiting global warming and to adapt to climate impacts. With governments focussing here on ways to most effectively finance the implementation of their agreed upon nationally determined contributions (NDCS), many public and private finance actors are aiming to take advantage of the strong political signal delivered by the Paris Agreement, and the numerous investment opportunities the NDCs give (CPI, 2017).

Overall, substantive investments are required for a greening of growth (s. Figure 2-1). Existing and future investments have to be greened to avoid adverse climate and other environmental impacts that can erode from new green developments, for which additional investments are needed (WEF, 2013):

- It will require a major diversion of scheduled investments from the fossil-fuel industry and other high-carbon capital infrastructure towards renewables, energy efficiency, and other low or negative carbon technologies.
- Beyond business-as-usual spending in investments for global growth, additional investments for green growth are needed, for example, to limit climate-change temperatures increases to 1.5 to 2 Celsius degrees above pre-industrial levels.

In 2016 global climate finance already surged to USD 383 billion of which USD 242 billion were climate investments by private actors and of which USD 141 billion were public finance actors (CPI, 2017). Both public and private levels of funding of green investment need sustained growth to ensure that we get on a pathway to meeting investment needs in 2020 and beyond.

Figure 2-1: Investments required for green growth



Source: World Economic Forum (2013)

Yet, an investment gap is expected. Current levels of investments are insufficient to support an environmentally sustainable economic system. Concerning the global investments needs for achieving the set goals, however, there are large uncertainties. In addition, estimates of infrastructure demand can vary widely, due to differences in definitions and assumptions about growth. Most estimates to date have had a focus on climate-related investment needs towards reducing greenhouse gas emissions (mitigation) and/or to reduce the risks and impacts of climate change (adaptation). Furthermore, the existing studies underestimate the volume as they do not cover all sectors and types of actions for a low-carbon, climate-resilient transition, notably for non-energy carbon emission reduction e.g. in agriculture and forestry and for adaption (I4CE, 2018). Hence, a comparison of the estimates is difficult.

Despite the limited comparability, the different studies offer a pretty clear picture on the investment needs at global level (s. Table 2-2):

- **To achieve the climate target:** A shift in long-term investment from conventional to green alternatives is required to limit the global mean temperature rise below 2 degrees Celsius. Estimates for required business-as-usual investments range from USD 5 to 6 trillion. Additional investments to fulfil the Paris climate target (2 degrees Celsius scenario) amount to between USD 0.3 to 0.7 trillion per year leading to an overall investment requirement between USD 6 and 7 trillion annually (Bhattacharya et al, 2016; GCEC, 2016; OECD, 2017; WEF, 2013).

- **Required energy transition to fulfil climate target:** A massive energy transition would not only increase capital expenditure, but also require a fundamental reorientation of energy-supply investments and a rapid escalation in low-carbon demand side investments. Looking

at energy-related investments it shows that overall investment requirements per year would be at around USD 2 to 3 trillion, of which 0.2 to 0.6 trillion would additional investments to fulfil the target (OECD/IEA, 2014; OECD/IEA/IRENA, 2017).

- **To comply with the Sustainable Development Goals (SDGs):** Available sectoral needs assessments that are broadly consistent with the SDGs focus mainly on low-income and lower-middle-income countries, but two studies approximate under strong assumptions the investment needs at the global level. According to UNCTAD (2014) total investment needs are in the order of USD 5 to 7 trillion per year between 2015 and 2030, of which on average around USD 3.3 to 4.5 trillion (average: USD 3.9 trillion) will be required in developing countries alone for basic infrastructure, food security, climate change mitigation and adaption, health and education. With current investment volumes in these sectors amounting to USD 1.4 trillion, this implies an annual investment gap of USD 1.9 to 3.1 trillion (average: USD 2.5 trillion) for developing countries alone. Schmitz-Traub (2015) estimates in a meta-analysis of other studies, including UNCTAD (2014), incremental investment needs in low-income and lower-middle-income countries only to amount to USD 1.4 trillion per year between 2015 and 2030. Combining estimates to global level (under strong assumptions) yields incremental SDG investment needs of USD 2.4 trillion per year over the time period.

Overall, this review of existing estimates at the global level shows clearly that further financial sources are needed to match the higher investment requirements of the future. This also applies to complying with the EU 2030 Energy and climate goals in the European context. Despite the limited comparability of the different studies, it shows that there is also a financing gap. Additional annual investment needs compared to current investment levels are estimated to range between Euro 0.1 to 0.3 trillion at the European level (European Investment Bank, 2016; Trinomics, 2017; EU Commission, 2017b).

Table 2-2: Estimates of infrastructure investment requirements

In USD trillion (different base years)

Literature Source	Time Frame	Coverage	Annual investment need		
			Business-as-usual	Additional to reach target	Total
Climate target: to reach 2 degrees Celsius goal					
WEF (2013)	2010-2030	global	5	0.7	5.7
GCEC (2016)	2015-2030	global	6	0.3	6.3
OECD (2017)	2016-2030	global	6.3	0.6*	6.9
Only energy-related investments					
IEA/OECD (2014)	2014-2035	global	2.2*	0.2*	2.4*
OECD/IEA/IRENA (2017)	2016-2050	global	2.8*	0.6*	3.4*
Sustainability target: to comply with SDGs					
UNCTAD (2014)	2015-2030	global	-	-	5-7
		developing countries	1.4	1.9-3.1 (Ø 2.5)	3.3-4.5 (Ø 3.9)
Schmidt-Traub (2015)	2016-2030	global	-	2.4	-
		low-/lower middle-income countries	-	1.4	-

*own estimation based on timeframe and available investment data for the entire period.

Sources: own compilation und own estimations based on listed literature

2.4 Green bonds – a suitable match to meet higher investment needs?

Finance is a keystone for the successful implementation both of the 2030 Agenda as well as the Paris Climate Agreement. A main reason for assessing the alignment of financial assets with a low-carbon, climate-resilient transition are the necessary shift of financial flows towards low-carbon, climate-resilient investments to achieve the Paris Agreement. Further, financial institutions are increasingly exposed to the risks relating to climate-related transition risks, e.g. floodings or other weather-related risks (I4CE, 2018).

Following instruments are available to finance green projects:

- Grants are predominantly supplied by international organisations for special projects.
- Debt, e.g. loans and bonds, have a fixed maturity and generate a fixed income for the investors. Thus, the return for the investor is unrelated to the success of the green project. What the investors has to evaluate is the probability of default of the debtor.
- Equity has an infinite maturity and the income for the investors depends on the success of the green project. Equity instruments have the advantage that once issued, there is no risk for the issuer that the shareholder can easily withdraw their investments. Since the dividends are connected to the cash-flows of the green project, equity instruments can better account for the life cycle of the green projects than bonds. However, equity instruments are more risky from the viewpoint of the investor.
- Guarantees are necessary, when private investors are hesitant to invest in green projects, which are unprofitable in the short-run, but profitable in the long-run. Because of the short-term investment horizons, these projects would be too risky to investors although they inhibit a smaller risk in the long-run. Guarantees can be combined with bonds, e.g. in the Project Bond Initiative of the European Commission and the European Investment Bank, which aims at making large infrastructure investments attractive to capital market investors.

Subsidized loans, e.g. by the European Investment Bank, also finance green investments, but green bonds have the potential to be a market solution to achieve green growth. Green bonds have been identified by various financial market actors as a key instrument of climate finance. The bond market, which includes longer-term debt instruments delivered by governments, regions, municipalities and enterprises, is mainly used to change illiquid assets into tradeable assets, backed by securities. Since bonds make up the largest single asset class in the financial system, it is possible to issue many green bonds (Berensmann / Lindenberg, 2016).

Public and private finance at the national but also at the international level are required to mobilise adequate capital to finance green projects. Private capital plays an important role to finance this transition as the scale of the investment challenge is beyond the capacity of public funds alone. Especially in times of high government indebtedness it is crucial for the private sector to contribute to financing the greening of the economy. As can be seen from Table 2-3, the volume of bonds issued by non-financial companies is twice as large as the volume issued by sovereigns.

The financial sector is regarded to play a key role in reaching these goals as it can re-orient investments towards more sustainable technologies and businesses. Moreover, it can finance growth in a sustainable manner over the long-term and can contribute to the creation of a low-carbon, climate resilient and circular economy. Furthermore, businesses will need capital for green investments to move on a more sustainable path (European Commission, 2018b). However, there is a mismatch between the top-down growing demand for green finance and the insufficient bottom-up funding of green projects.

Table 2-3: Size of global bond market and green bond market potential

In billions of US-Dollar, amounts outstanding at end-September 2017

	Financial corporations	Non-financial corporations	Governments	International organisations	All
All Bonds, September 2017	16,401	3,607	1,897	1,706	23,581
Estimated climate-aligned bond market size					
At current market share	623	137	71	65	895
Estimated unlabelled climate-aligned bonds					
At current market share	469	103	53	49	674
Estimated labelled green bonds					
At current market share	154	34	17	16	221
Estimated issuance in 2017	109	24	12	11	156
Scaled by factor 10	1,085	239	124	113	1,560
Scaled by factor 30	3,255	716	371	339	4,680
Scaled by factor 50	5,425	1,193	618	564	7,800

Sources: Bank for International Settlements (2018), Climate Bonds Initiative (2018a, 2018b), own calculations

One possible answer is the climate-aligned bond market, which has increased substantially over the past years from below USD 400 billion in 2013 to USD 895 billion in 2017 (Climate Bonds Initiative, 2017). To date the majority of these bonds, which are used to finance low carbon and climate-resilient (LCR) projects do not carry a green label yet. The global outstanding amount of all bonds sum to USD 23 trillion, from which climate-aligned bonds sum currently to only USD 895 billion (3.9 % of total bonds volume). Of these around USD 221 billion have a green label, of which USD 156 billion have been issued in in 2017 (s. Table 2-3). These available bonds would only be able to cover a small fraction of the future investment requirements towards a green(ing) infrastructure:

- Looking at the investment requirements needed to reach the Paris climate target the current bond volume of climate-aligned bonds would only cover the estimated annual additional investment needs (USD 0.3-0.7 trillion), but the issuance volume of labelled green bonds would have to increase by the factor 1.9-4.5. However, as part of the transformation process greening of existing infrastructure is necessary as well, leading to an overall investment requirement of USD 6 to 7 trillion. To meet these capital needs, demand for green bonds and

the annual issuance volume needs to scale by the factor 38.5-45 of the current green bond issuance volume (2017). The question here is, however, what share of all future business-as-usual investments are part of a "greening" process and are entitled to be financed via climate-aligned or labelled green bonds.

- To meet the incremental investment needs of USD 2.4 trillion to comply with the Sustainable Development Goals according to Schmidt-Traub (2015) an increase of the annual demand for climate-aligned bonds by the factor 3.6 of the current outstanding amounts would be necessary. Relative to the current green bond issuance (2017), green bond issuance would have to increase by the factor 15.

- Financing the annual amount of USD 5 to 7 trillion of total investment to reach the Sustainable Development Goals according to UNCTAD (2014) would need an increase of the annual issuance volume of green bonds by the factor 32 to 45 compared to the current green bond issuance volume (2017). Therefore, increases in bond investments by 3100 to 4400 percent are necessary. The question is whether the financial sector could absorb the additional supply of green bonds.

The estimated numbers imply that a fast growth of the green bond market is necessary in order to finance the annual investment needs. The accelerated issuance of green bonds, however, requires a combination of an increased indebtedness or significant shifts in investors' portfolios towards green bonds.

3 Incentivising green investments relying on market intelligence

The European Commission has identified a financing shortage of green investments that cannot be filled by public funds only. Therefore, it intends to re-direct private capital into green investments. It seems at the moment that a re-direction of capital flows should be achieved by influencing investment decisions through regulation. Whether changes in regulatory frameworks will promote a more efficient financing of green and sustainable investment or whether regulation will distort investment decisions towards political objectives will be analysed in this section.

3.1 Policy goal versus decentralized investment decisions

The policy goal of re-orientating financial flows towards green and sustainable investments can only be justified from an economic point of view, when there is a market failure in financing green projects. That means, market participants' investment decisions are biased towards investing in projects that exert negative external effects, i.e. in projects that harm the climate. However, in the absence of any negative external effects such a re-orientation of investment flows would undermine the market's selection and monitoring function and it would have a central-planning character.

The current discussion about the introduction of a green-supporting factor at EU level has such a central planning character. Because banks play a major role in financing the economy, they should be incentivized to lend money for green investments. To this end, the European Commission intends to lower the capital requirements for these activities (Dombrovskis, 2017). Since bank capital is a buffer against unexpected losses, the aim of bank capital regulation is to ensure, that banks hold sufficient equity capital in proportion to their risk exposure. The criterion for holding equity capital against unexpected losses is the probability of default. Since equity capital is a limiting factor for investment decisions, the design of bank capital regulation has a direct impact on banks' demand for certain types of assets. A green supporting factor is defined as a lowering factor for banks capital surcharges for investments that qualify as green. It has the effect that banks could hold less equity capital against the unexpected losses of a green bond compared to the potential losses from the same investment in a conventional bond. Thereby, the loosening of equity capital restrictions would make green bonds more attractive to banks. The only justification for lower capital requirements for green bonds is a lower probability of default compared to conventional bonds. But as long as this is not the case, the green supporting factor would cause that banks would be undercapitalised against the losses from green investments, which would lead to an overexposure of the financial sector to green investments and their default risks. Since the green bond market is a political project, there is the danger of privileging green bonds in financial regulation for achieving political goals.

The risks, which arise from reaching political goals through the financial system, have materialized in the US subprime housing bubble. The US made the mistake to boost housing investment by the Community Reinvestment Act, which aimed at banks to expand lending to households. The EU should not make the same mistake and overuse the financial system to reach ecological goals. The emergence of a green bond bubble and the bursting of that bubble would be harmful to the financial sector and it would hinder reaching the climate goals, since investors will abstain from investments in which they have lost money before.

Better than directing capital flows by regulation would be to remove barriers to green investment projects, e.g. informational asymmetries that hinder the purchasers of green bonds to assess the greenness of a green investment, while relying on the market's selection and monitoring functions. That means that market participants should evaluate all available investment opportunities and invest their money into the projects with the highest risk-adjusted returns. Thereby, investors evaluate and monitor the probability of default of the project they are invested in and demand a higher risk-premium when the default probability rises. These market functions also apply to financing green projects.

Undermining the market's selection and monitoring functions would steer capital into the projects that politics favour, which need not necessarily be the ones with the highest value. More problematic will be if capital is steered into badly evaluated and monitored projects with a high default probability. Under these circumstances, capital will not only be wasted, but there will also be no benefit in reaching the climate goals. Therefore, policymakers have to be careful in incentivising the financing of green investments by financial regulation.

From a policy point of view, the question is, whether there is a bias towards financing projects with negative external effects or whether there are barriers for investors to invest in green projects:

- A bias towards financing projects with negative external effects will exist, if these projects yield higher risk-adjusted returns compared to climate-neutral or climate-improving projects. Such a bias will only exist in the short run, since the long-term effects of climate-change increases for example disaster risks, which also endangers the stability of financial markets. Therefore, investors should care about their long-term impact on climate-change. The high demand of investors for green bonds and the divestment of investors in sectors such as coal are a hint at investors caring about climate-change to some degree. However, the long-term consciousness of investors could be in conflict with short-term incentives of investors, which causes a bias in their investment decisions. Thus, there seems to be no bias towards financing negative external effects, but financing negative external effects often fits better to shorter investment horizons than financing green and sustainable projects. A liquid market for divisible and standardised financial instruments for the financing of green projects, i.e. a market for green bonds, could be a solution for aligning the investors' short-termism with the long-term nature of green projects. Such a market already exists, but it is still small in size.

- In case that investors are willing to finance investments in green technology in the short-term, there could still be barriers to their investment decisions resulting in an underinvestment in green projects. These barriers could be caused by asymmetric information between the issuer of a security to finance a green project and the investor. From the investors' point of view, there is asymmetric information about the use of the proceedings. The issuer could have told the public that he or she wants to raise money for investments into green technology. After the investors have purchased the security, the investors cannot monitor whether the proceeds will be used to finance the green technology or whether the funds are used otherwise. Another problem between the investors and the issuer could be that they have different views about what a green technology is and whether the investment project proposed by the issuer is a green project in their view. When monitoring the probability of default of the issuer, investors can rely on quarterly balance sheet data and the ratings of credit rating agencies, which are standardised. But when it comes to the evaluation of green projects, investors cannot rely on financial statements. Even when the issuer describes his or her green projects in the financial statements, investors will have a hard time in evaluating these as long as the information on the greenness is not standardised. From this is clear, that standardised information on green projects is essential to investors. The question is not whether, but how this information should be disclosed and reported to investors.

3.2 The demand for green bonds

Securities markets connect investors to green projects. These projects are often of a long-term nature, they are large, their cash-flows are lower at the beginning of the project and higher at

the end of the project, the direct investment is highly illiquid and these projects cannot be standardised. The illiquidity of the projects do in general not fit with the investors' short term view. The bond market can overcome this matching problem due to the contractual features of the bond:

- Divisibility: The issuance volume can be divided into many securities. Thereby the investors can choose on how much money he or she wants to invest into the green project instead of investing large sums into one single green project. In addition to that, bonds allows investors to diversify their risks over many green or traditional projects.

- Fungibility: A bond can easily be sold to other investors in secondary markets. Instead of engaging in green projects for the long-term, investors can purchase a green bond and sell the bond before maturity. Investors with a short-term investment horizon are more willing to invest in projects from which they can exit easily.

- Standardisation: As a standardised financial instrument, the bond fits certain definitions in financial regulation, which makes it easier for investors to fulfil capital requirements and investment guidelines. In addition to that allows standardisation that the bond can be traded in liquid markets.

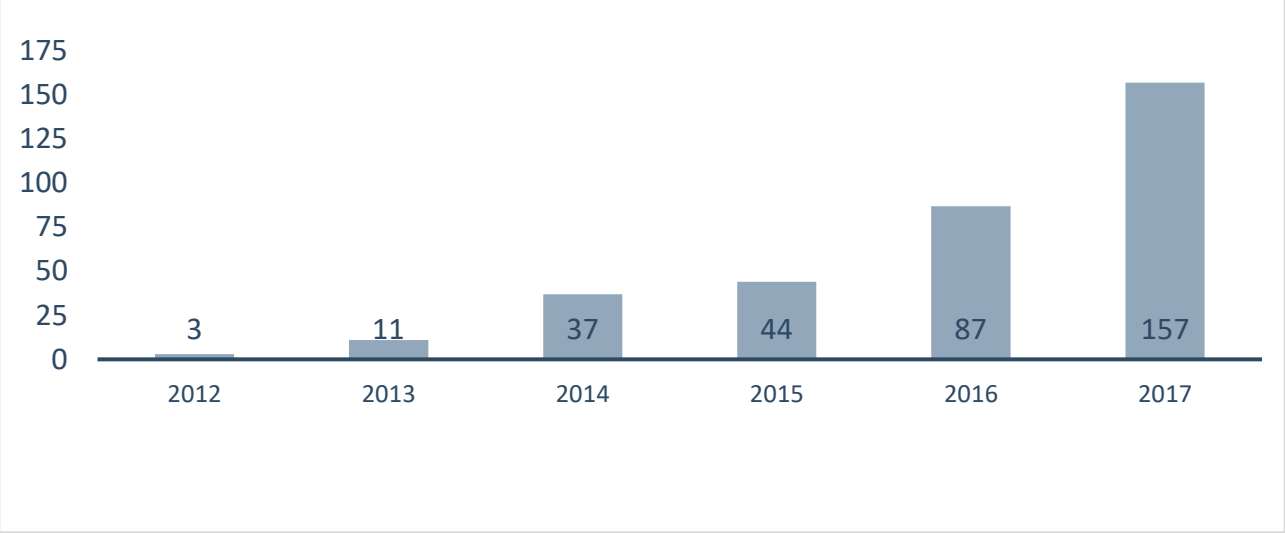
- Fixed income: The bond pays an annual or sometimes also bi-annual coupon to the investors, which makes it easier for the investors to predict the cash-flows from his or her investment. Moreover, the investors also receives the fixed coupon at earlier stages of the green project, when the project is not profitable yet, given the solvency of the issuer.

Thus, green bonds enable investors to engage in long-term green projects, while meeting their portfolio objectives and risk management objectives and regulatory requirements at the same time.

There is a growing demand of investors for green bonds. For example, France has issued a green sovereign bond with an issuance volume of 7 billion Euro and a time to maturity of 22 year. The bond was three times oversubscribed (Eisinger et al., 2017). Over the past 5 years the volume of green bonds issuance volume has grown enormously: While a global volume of USD 3 billion of green bonds was issued in 2012, the issuance volume increased to 157 billion in 2017. Since 2015 the volume of issued green bonds increased by more than 250 percent alone. Between 2016 and 2017 the volume almost doubled (s. Figure 3-1).

Figure 3-1: Green bond issuance

In USD billions



Source: Seeking Alpha (2018)

Many investors intend to engage in sustainable investments. A study for Germany reveals that 64 percent of the surveyed market participants already care about sustainability criteria in their investment decisions, while 37 percent of the assets are based on investment decisions that take sustainability into account (Union Investment, 2017).

For the green investor it is important to know whether the proceeds of his or her investment are exclusively used for green projects. Since financial statements lack of standardised information on the greenness of projects, other reporting means can be used to signal his or her investors' compliance:

- Green Bond Principles are voluntary guidelines. They define criteria for the green project, which the issuer intends to finance by issuing green bonds. Moreover, they define processes for the evaluation of green projects and define the systems for tracing the green bond proceeds and the way of reporting on the use of the proceeds to the investors.

- The Climate Bonds Initiative has developed a standard for the certification of green bonds. Within this standard the issuer has to identify and disclose the green projects first. He or she has to ensure that the proceeds of the green bond are not used to finance other business activities. Moreover, the issuer has to create a verification report, which is the basis for certification.

- The High Level Expert Group recommended the European Commission to introduce an official European standard for green bonds based on the EU Sustainability Taxonomy. Thereby, an EU green bond is defined as a listed bond that fulfils the three requirements: (1) the proceeds will be exclusively used to finance or re-finance in part or in full new or existing green

projects, (2) the issuance documentation confirms the alignment with the EU Green Bond Standard, and (3) the alignment of the bond has been verified by an independent and accredited external reviewer.

Since the market for green bonds is new and still small, the market is not working without disruptions, since liquidity is still low in this market segment and the bonds lack common definitions and standards. However, when the market evolves and becomes more liquid over time, green bonds enable investors to diversify their portfolios towards more green assets with positive effects on their corporate image. Moreover, there might also be an increased demand for greener assets in portfolios from the customer side, which forces investors be become greener.

The increased demand for green bonds can either be due to more awareness of sustainability and the downsides of climate change, but it can also be due to the fact that green bonds are more transparent than traditional bonds. For an investment in a traditional bond, there is only limited information about how the proceeds will be invested, while the issuers of green bonds have to signal the greenness in the use of proceeds by giving more information to investors.

Compared to the due diligence for conventional bond investment the investor has to conduct additional due diligence for green bonds, i.e. he or she has to assess the greenness of the bond. If information on the underlying green projects is not standardised or if there are competing green bond standards, the investor has to do a lot of research in order to extract the relevant information for his or her investment decision. Information gathering might be easier for companies, which are already active in the green sector, but more difficult for companies that intend to green their production lines or their buildings. Although investors have become more eco-friendly, investing in green bonds is associated with higher research costs. A challenge for the green investor will be that he or she does not only have to manage default risk and interest rate risk, but also the risk that the issuer of the green bond is non-compliant with the green bond standards. If the investor holds the green bond for image or marketing purposes, he would lose the utility of holding the bond, if the bond loses is status as a green bond.

3.3 The supply of green bonds

Green bonds can be issued by central governments, states and municipalities, by banks or by corporates. In order to match supply and demand, other markets participants are necessary. These market participants form a value-chain for the green bond issuance

- Underwriters: Investment banks assume a risk for purchasing the bonds from the issuer and sell the bonds to investors. However, the underwriters are not the only market participant that estimates a default risk.

- Credit rating agencies: These agencies evaluate the company and predict their default risk. They give the company a standardised credit rating, but also evaluate the greenness of the bonds. However, they do not mix credit rating and greenness, since both are unrelated to

each other in most cases. Forcing credit rating agencies by regulation to also apply ESG-factors in their risk assessment would bias the result of the credit risk assessment, which would increase the risks to the financial system. A better way would to do credit rating and green certification in independent entities.

- Index providers: Although the inclusion in or exclusion of a security into an index should not have any effect on securities prices, market reactions to the index inclusion or the index exclusion can be observed. Securities rise in price, when included in an index, and fall in price, when excluded from the index. This anomaly represents a regularity in securities markets (Barberis/Thaler, 2003). By developing green bond indices, like the S&P Green Bond Index or the Barclays MSCI Green Bond Index, index providers have a huge impact on the development of the green bond market.

- International standard setters: These agencies, like the Climate Bonds Initiative or the Financial Stability Board (FSB) have a huge impact on the market, since they develop globally agreed guidelines for the standardisation of bonds. Financial supervisors often use these guidelines to develop technical standards. Moreover, these guidelines often are used by legislators in the preparation of directives.

Technical standards are important for market participants for assessing the greenness of bonds. Since every issuer can, in principle call his or her bonds green, an adverse selection problem can arise which could bring the market to break down, since the investors often lack of the information to differentiate between true green bonds and false green bonds. Because investors do not want to have false green bonds in their portfolio, they might underinvest in green bonds. Standardised issuer information and rules for the disclosure of this information could help to overcome this problem. Moreover, certificate providers could label bonds as green. The issuer could provide the certificate provider with additional information, which he or she does not want to disclose to the general public, for the evaluation of the greenness of the bond.

This raises the problem that the issuer faces uncertainty over which green bond standard to use. Therefore, the question arises whether the EU should have its own green bond standard and which criteria of the EU green bond standards fits best to the EU.

3.4 Making supply match demand

Because of the high demand for green bonds there seems to be little need to stimulate it even further. Moreover, there is also a limited need for stimulating the supply of green bonds, because such measures could lead to a situation in which issuers declare bonds as green although they are not or try to establish projects that are green, but with a low success rate. Promoting a green bubble would be counterproductive for reaching the climate goals.

A better approach would be to help the market match supply and demand. Investors need information and transparency on the impact of the underlying investment project for stopping climate change for the evaluation of the greenness of bonds. Standardised disclosure rules that

provide investors with the needed information, but do not overburden the issuers with bureaucracy and litigation risks through undefined rules. Litigation risks are one factor that cause a low issuance volume of green bonds in the US (Allen, 2018).

How should investors monitor green investments? Green bond investors need information on the impact of the investment project on fighting climate change as well as information on the credit risk of the issuer. At the beginning of the project, investors can only rely on the expected impact of the green project on climate change. Thus, they have to do their investment decision under uncertainty, when it comes to evaluating greenness. Commonly agreed green bond standards would help investors to evaluate the greenness of the bond.

4 How should policy get investors to invest in green bonds?

The European Union is currently making significant strides to lead on green finance and align its financial system with its climate, sustainability and clean energy ambitions. The Paris Climate Agreement, the G20 Green Finance Study Group and the G19 Hamburg Climate and Energy Action Plan have provided ongoing momentum for policy moves towards a green financial system. Including financial markets into a climate strategy is a logical step forward, because public funds are insufficient to finance the needed investments in green technology and because the financial sector shows interest in financing green technology.

Given the long-term nature of green investments and the financial market's short-termism, the establishment of a liquid market for green bonds is the market solution to this maturity mismatch. However, for such a market to thrive, investors need a definition of green technology as well as a definition of what a green bond is. In addition to that, green disclosure rules are needed, so that investors can easily access information on how the proceedings of green bonds are invested.

The EU's main efforts in establishing a market for green bonds are the legislation of a common taxonomy for green bonds and the stimulation of the demand for green bonds by a green supporting factor in bank capital regulation. While we agree that a common taxonomy will help investors to screen green projects, we are very sceptical about the green supporting factor, which causes lower equity capital requirements for green investments. We see the risk that this may give rise to an undercapitalisation of banks with respect to the default risks of green projects and an overinvestment of banks into these projects. Since the green bond market is a political project, there is the danger of privileging green bonds in financial regulation for achieving political goals. The emergence of a green bond bubble and the bursting of that bubble would be harmful to the financial sector and it would hinder reaching the climate goals, since investors will abstain from investments in which they have lost money before.

We derive the risk of political interventions to stimulate the demand for green bonds from our estimates, which indicate that annual green bond emissions have to grow by the factor 45 in order to finance the potentially needed overall annual investments of up to USD 7 trillion making

a higher indebtedness or significant portfolio shifts necessary. Looking only at incremental investments needs to reach the climate goal green bond issuance would also have to increase up to the factor 4.5 and to reach the Sustainable Development goals by the factor 15.

Instead of pushing for a fast growth of the green bond market, the EU should strive for its organic growth. Therefore, it should rely on market intelligence, i.e. the market participant's risk assessments for the green projects' default risks together with the market participants evaluation of the greenness of green investment projects. To this end, the proposed harmonisation of the taxonomy within the EU is a necessary step, because different national taxonomies would hinder the emergence of cross-border markets for green bonds. The EU cared about the consistency of the green bond proposal with other regulations for financial institutions, but it would be necessary to guarantee consistency also in the future. Otherwise, unintended side effects could distort the investment decisions of financial companies.

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