The Cost of Being Green

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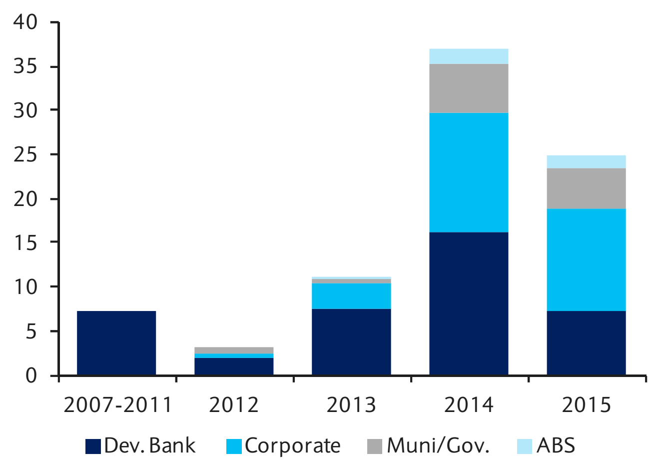
- **The market for "green bonds," whose proceeds are earmarked for environmentally beneficial purposes but are otherwise identical to unsecured issues, has grown tremendously in the past four years.**
- **After starting almost exclusively as securities of global development banks and other government-affiliated institutions, the universe of green bond issuers has expanded recently to traditional corporates, including high yield issuers.**
- **Investors are currently paying a premium to acquire green bonds, at least in the secondary market. Our model finds an approximately 20bp difference between the spread of green bonds and comparable issues, which we see as partly attributable to opportunistic pricing based on strong demand from environmentally focused funds.**
- **Although the green bond universe is still a small percentage of the corporate credit universe at around $65bn, the influx of traditional corporate issuers (especially in light of the current spread discount), anticipated growth from emerging markets (including China and India), and increasing investor interest all suggest that the segment's growth will continue to outpace that of broader credit indices.**

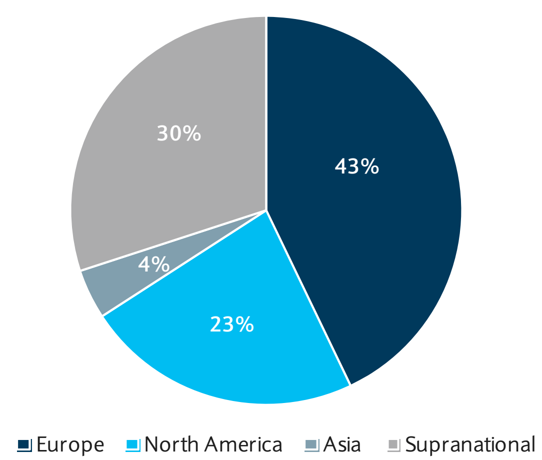
Green bonds – essentially traditional debt instruments intended to support environmentally friendly institutions and projects – are a relatively recent innovation in the credit markets. They have grown rapidly as an increase in issuers who want to promote green initiatives has paralleled an increase in investor mandates with an environmental, social, and governance (ESG) component. The AUM of funds that incorporate ESG in their decision-making increased eightfold from 2010 to 2014, to more than $4trn.[1] As these mandates multiply, we think it is worthwhile to provide an overview of the market, clarifying what it means to be "green" (for details, see the section "What Makes a Bond Green?").

FIGURE 1
Annual Green Bond Supply by Issue Type ($bn)



Note: Data through September 8, 2015.
Source: Climate Bonds Initiative, Barclays Research

FIGURE 2
Distribution of Green Bond Universe by Issuer Region



Note: Universe is Barclays Global Green Bond Index plus high yield issuers.
Source: Barclays Research

[1] "U.S. Sustainable, Responsible and Impact Investing Trends 2014" – The Forum for Sustainable and Responsible Investment

We also consider whether the financial performance of green bonds is likely to diverge from the broader credit markets. In our conversations with investors, we have not yet encountered mandates that specify a price (in terms of foregone return) that investors are willing to pay for their environmental friendliness. This may be a challenge for the sector – while the potential financial benefits of green bonds are nebulous and the returns have historically been in line with conventional bonds, it is increasingly clear that green bonds trade at tighter spreads than otherwise similar conventional paper. If that spread divergence continues, investors and their sponsors will need to consider exactly how much they are willing to pay to be green.

Investors Pay a Green Premium

To quantify differences in compensation for green bonds, we ran a regression on credit spreads that decomposes OAS into common risk factors and an indicator variable for green bonds. As of mid-2015, green bonds trade a statistically significant 17bp tighter in OAS (Figure 3) after accounting for their other characteristics – including Moody's Weighted Average Rating Factors to account for credit risk, spread duration (OASD) to account for the investment length, and the time since issuance (binned by quartile) to capture the liquidity premium available in off-the-run securities. We also include a binary variable for the issue currency to capture valuation differences across markets in different countries (see the Appendix for specification details and the reports *High Yield Spread Model, Refined*, *144A-OK*, and *Losing Concentration* for further discussions of the model components). Our sample universe is the Global Credit Index, a multi-currency index that includes both corporate and government-related issuers and offers the best overlap[2] of constituents with the Global Green Bond Index.

FIGURE 3

Regression Results: Spread Compensation by Factor (bp)

					Time since Issuance			
	Green Bond	WARF	OASD	Currency	2nd Quartile	3rd Quartile	4th Quartile	Constant
Coefficient	-16.7*	0.3*	8.1*	-26.3*	7.8*	7.1*	12.5*	28.2*
Standard Error	7.7	0.0	0.1	1.3	1.7	1.7	1.7	1.8
T-Statistic	-2.2	101.7	57.5	-21.0	4.6	4.2	7.4	15.4
Adjusted R^2	0.57							
F-Statistic	2197							

Note: * after coefficients signifies statistical significance at the 5% level. Sample consists of Global Credit Index universe as of August 31, 2015. Source: Barclays Research

The model captures the majority of the variation in credit spreads, with an adjusted R^2 of 0.57 in the most recent sample. Figure 3 shows the regression statistics; all variables have a statistically significant effect on credit spreads. Not only is the spread economically significant (about 10% of the total spread compensation for the average bond in the regression), the green bond investor premium has increased steadily as the market has grown. We ran our analysis on seven cross-sectional samples of the index – quarterly since the beginning of 2014, plus at the end of last month – and Figure 4 shows the progression of the spread gap between green bonds and other bonds. We note that the green bond variable has been statistically significant only in the past three time periods, and we are not surprised by this trend, given the steadily increasing sample set of green bonds.

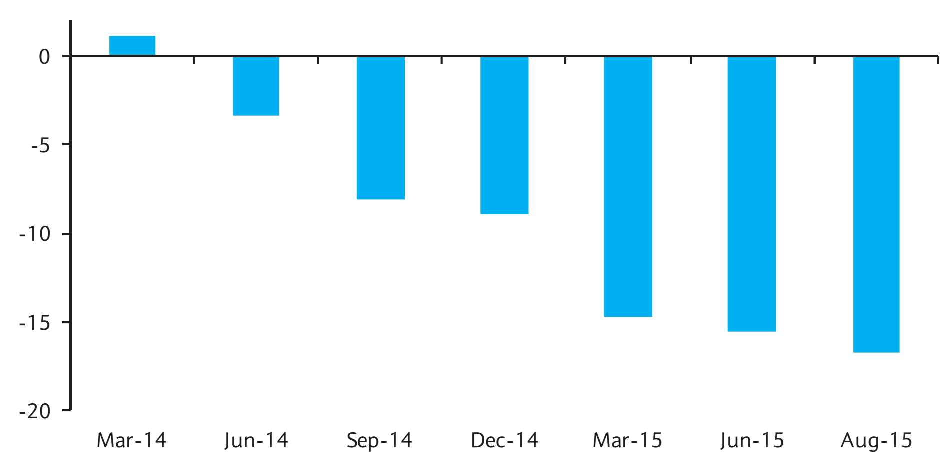
[2] We exclude green securitized bonds, as securitized bonds are not in the Global Credit Index and have other relevant valuation metrics. We also limit the Global Credit Index to its investment grade constituents, since the Global Green Bond Index includes only investment grade issues.

We see a number of potential explanations for the difference in valuation:

- It may reflect the growing interest in the product and a resulting mismatch between the supply of and demand for green issues. Press reports[3] of heavy oversubscriptions to new deals support that thesis. In that case, the spread differential might not continue indefinitely. If issuers see an opportunity for cheaper funding, we expect that they will gravitate toward the market; at the same time, the lower future returns implied by tighter spreads might slow the inflows to funds with green mandates.
- Some market participants have suggested that green bonds should trade at tighter spreads to reflect their externalities, such as mitigating climate risk through their commitments to environmental projects. While it is not impossible for that to be the case, it is extremely difficult to quantify. In addition, because green bond owners are not the residual claimants on the benefits (which would accrue broadly), it is not entirely clear why conventional bonds would not also receive the benefits from the existence of green bonds (keeping spreads aligned).
- Green bonds' tighter spreads could reflect a simple preference on the part of investors, which could be the case if investors accrue enough other benefits to offset the lower cash flow. These benefits could be in the form of psychological benefits for investors, brand value, influence with regulators, or other indirect gains. We are cautious about this explanation, because we have not encountered investors that have been willing to put an explicit price on being green. For instance, institutional investors "expressed an unwillingness to accept lower yields" on green bonds in meetings conducted by the NYC Comptroller's Office in its efforts to develop a green bond program for the city[4]. Our conversations with multiple green-mandate portfolio managers suggest that they have a bias toward green issues, but only when they receive risk-adjusted compensation that is equivalent to conventional investments.
- It is possible that green bonds are actually less risky or volatile than otherwise similar conventional bonds, making the tighter spreads appropriate to their risk-adjusted return. In the same vein, some market participants have suggested that having environment-focused investors (who might be longer-term investors) as the marginal buyer of green debt could reduce trading activity and lead to greater price stability of issues. Although we are not certain of the underlying cause, the empirical evidence does not rule out this explanation, which we examine in more detail in the next section.

FIGURE 4

Green Bond Investor Premium Has Increased over Time (bp)

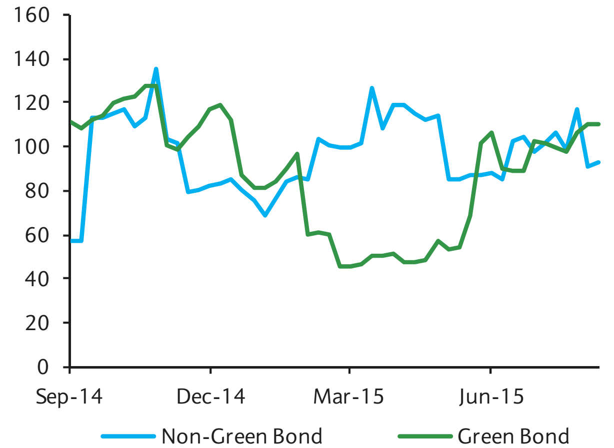


Note; Regression coefficient on green bond variable in seven cross-sectional samples of the Global Credit Index.
Source: Barclays Research

[3] "Green bonds: Green grow the markets, O" – The Economist
[4] "Update: A Green Bond Program for New York City" – Office of the New York City Comptroller

FIGURE 5

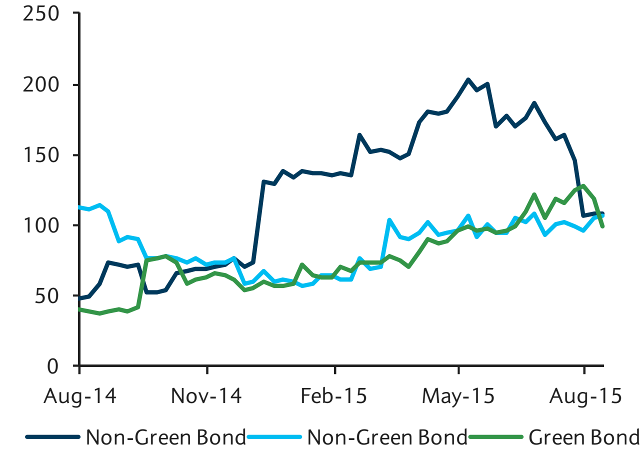
Volatility-Adjusted OAS of Vornado Realty Issues



Note: Green bond is 2.5% 2019 issue and non-green bond is 5% 2022 issue. Data through August 31, 2015.
Source: Barclays Research

FIGURE 6

Volatility-Adjusted OAS of Regency Centers Issues



Note: Green bond is 3.75% 2024 issue and non-green bonds are 4.8% 2021 issue and 6% 2020 issue. Data through August 31, 2015.
Source: Barclays Research

Volatility

We conducted a historical analysis to quantitatively test the lower volatility thesis. Our chosen measure of comparison was volatility-adjusted spread, for which we used OAS and rolling three-month total return volatility on a weekly basis. This measure provides a metric similar to a Sharpe ratio that also roughly incorporates differences in ratings and duration (through the OAS). We focused on corporate green bond issuers, since these bonds are more likely to benefit from lower trading activity than more stable and lower-yielding government-related issues, and restricted our analysis to intra-issuer comparisons.

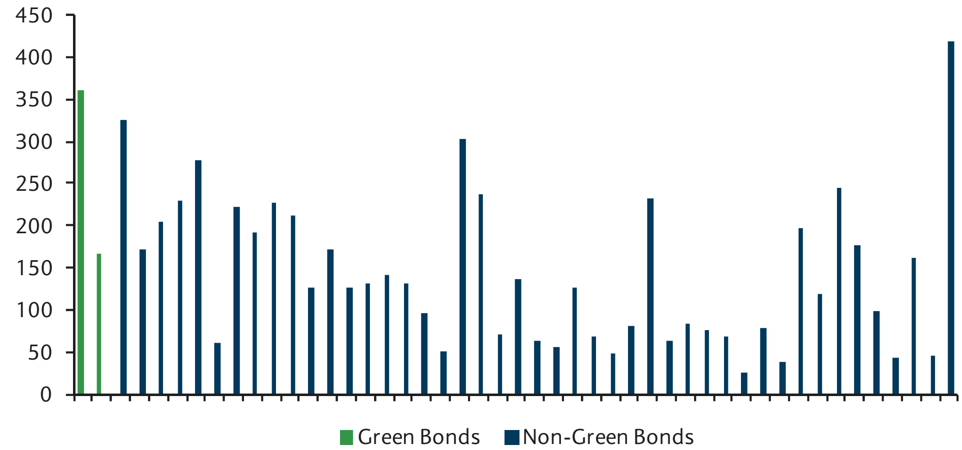
Overall, our analysis led to inconclusive results that neither confirm nor disprove the idea's validity. Figures 5 and 6 show the vol-adjusted spreads of Vornado Realty and Regency Centers, two investment grade REITs that issued green bonds in 2014. In both cases, the coupons and spreads of the green bonds are lower than their regular bond counterparts, which means that the non-green bonds would consistently look more attractive if volatilities were equal. That is not the case, as the green bonds have higher vol-adjusted spread at various points in time. The Vornado green bond currently looks more attractive based on this measure, while the Regency green bond slightly lags the two non-green issues shown.

We also calculated the measure for Bank of America, which has two green bonds outstanding. In this case, the volatilities of the two green bonds are quite low, which contributes to attractive adjusted spread measures, especially for the 1.35% 2016 green bond. Figure 7 shows the volatility-adjusted spreads of all Bank of America bonds at the end of August, and both green bonds are in the top half of valuation in the complex based on this measure.

While our volatility analysis is largely inconclusive, the Barclays Quantitative Portfolio Strategy team has also looked at the question of whether issues that score higher on ESG investing factors produce higher risk-adjusted returns (see *Performance of ESG Corporate Bonds*). The analysis shows potential for ESG attributes to provide incremental return after adjusting for risk. In our view, this raises the possibility that even with tighter spreads, green bonds may be able to match the risk-adjusted returns for conventional debt. That said, more experience with the product is needed before we can be confident about that conclusion.

FIGURE 7

Volatility-Adjusted OAS of Bank of America Bonds (bp)



Note: Data as of August 31, 2015. Includes all outstanding BAC bonds for which data were available. Green bonds are 1.35% 2016 issue and 1.95% 2018 issue. Source: Barclays Research

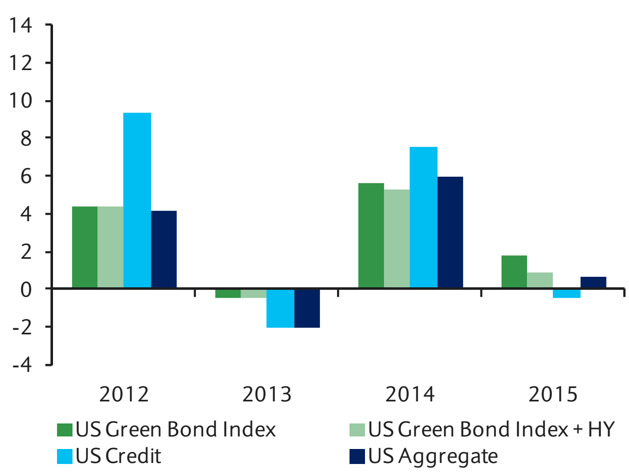
Historical Returns Have Been in Line with Conventional Bonds

The results detailed above of lower spreads and inconclusive volatility differences naturally lead to a question of value. Despite the current valuation difference, however, green bonds have historically earned total returns that are comparable with those of regular bonds. As seen in Figure 8, US green bonds have demonstrated a lower beta than the broad credit market in their brief history, with lower-magnitude returns in both positive and negative return years. This is reasonable, given the green bond indices' higher ratings profiles than the US Credit Index. The exception is year-to-date returns, as both the investment grade-only green bond universe and the high yield-inclusive one have outperformed.

Globally, green bonds have underperformed year-to-date on an unhedged basis, returning about -4% with high yield issues incorporated (Figure 9). However, the underperformance is attributable largely to currency exposures – it is no accident that Global Credit, the best performing index, has the largest exposure to USD issues (67%, versus 45% in the Global

FIGURE 8

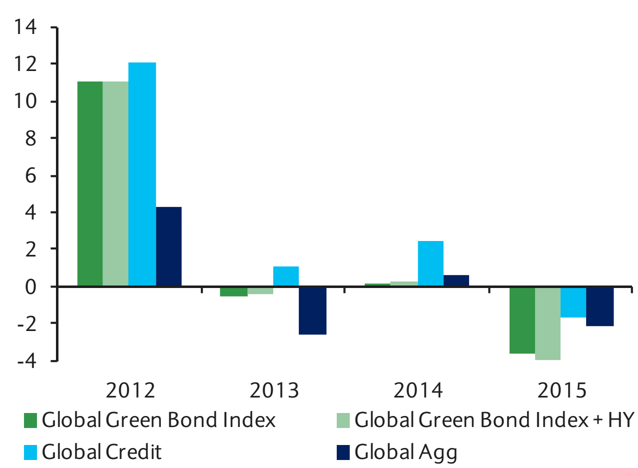
Historical Total Returns of US Green Bonds and Credit Indices (%)



Note: Year-to-date returns through September 14, 2015.
Source: Barclays Research

FIGURE 9

Historical Total Returns of Global Green Bonds and Credit Indices (Unhedged, %)



Note: Year-to-date returns through September 14, 2015.
Source: Barclays Research

Aggregate and 40% in the custom green bond index). On a fully hedged basis, all of the indices have returned less than 100bp year-to-date. We detail other compositional differences between green bond indices and other credit indices in the "Green Bond Characteristics" section.

What Makes a Bond Green?

The first "labeled" green bond was issued by the European Investment Bank (EIB) in 2007, and other supranational sovereign agencies (SSA) such as the World Bank entered the market in its early stages (Figure 1). In 2013, private companies, including Bank of America and the French utility EDF, issued the first corporate green bonds and helped issuance surpass $10bn. In the years since, green bonds have continued to attract new entrants, including high yield corporate issuers and municipals across various regions (Figure 2). Total issuance rose to nearly $40bn last year but has fallen off so far in 2015. Overall, there is about $65bn of green bonds outstanding globally.

Although there is no universally recognized definition for what makes a bond green, there are a number of efforts to formalize at least some of the necessary criteria and differentiate between green bond types.

- Labeled green bonds, the focus of this report, are bonds that have been designated "green" by the issuer, which signifies a commitment to using bond proceeds to fund environmental projects. The most widely accepted guidelines for labeled green bonds are the Green Bond Principles (GBP), first released in early 2014. The GBP provide guidance on four key aspects of a green bond's life, as seen in Figure 10. They were written by a subset of its member organizations, which include green bond issuers, investors, and underwriters (including Barclays). Crucially, what the GBP lay out is a *voluntary* set of rules regarding the green bond issuance process. The absence of explicit rules and market standardization is a common source of concern for participants in the burgeoning market.
- These are distinguished from unlabeled green bonds, which are conventional bonds from corporates whose businesses are naturally aligned with environmental projects. For instance, the regular bonds of "pure-play" wind and solar energy companies qualify as unlabeled green bonds. The unlabeled universe dwarfs the labeled universe; the Climate Bonds Initiative (CBI) sizes the market at around $530bn[5]. Within the unlabeled market, there is a small but growing pocket of securitized green bonds, whose cash flows depend on the underlying projects and/or assets. Securitized green bonds outstanding total about $15bn, according to CBI.

FIGURE 10

Summary of the Green Bond Principles (GBP)

Principle	Description of Issuer Responsibility
Use of Proceeds	Choose an eligible "green project" from a list of recognized categories, such as renewable energy
Process for Project Evaluation and Selection	Detail the decision process underlying project selection
Management of Proceeds	Ring-fence bond proceeds to be used for environmental projects
Reporting	Provide qualitative and quantitative metrics regarding the environmental impact of projects

Source: ICMA, Barclays Research

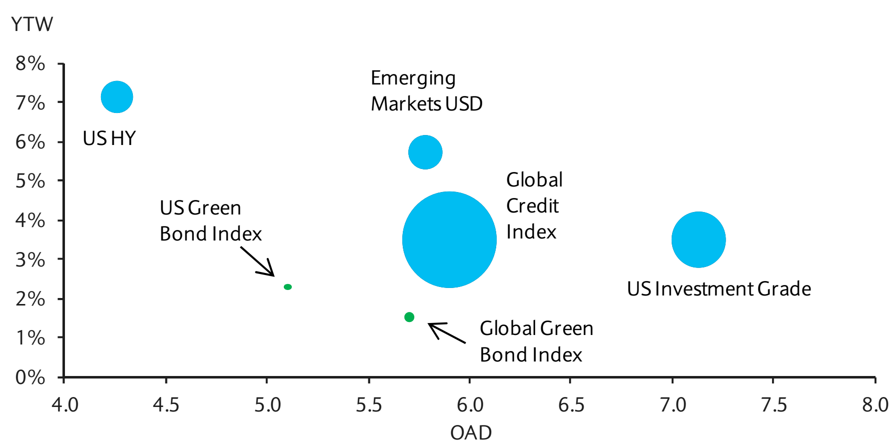
[5] "Bonds and Climate Change: The State of the Market in 2015" – Climate Bonds Initiative

Labeled green bonds have financial features that are identical to typical corporate bonds. Full recourse goes to the issuer, not to revenues derived from a specific project, and there are no particular "green" covenants or legal ramifications that bind issuers to their sustainability promises. The similarity of green and conventional bonds is intended to encourage market growth by taking advantage of comfort with the regular product, and it allows issuers to signal a commitment to sustainability without straying far from their traditional areas of expertise.

However, the convenience that the green bond structure provides to issuers and investors has also generated concerns. The term "greenwashing" has come to represent green bond issues that fund projects that lack sufficient environmental benefits, in the view of some market participants. Of course, the requisite level of greenness of a bond's use of proceeds is an extremely difficult measure to standardize, especially given the diversity of project areas, and it will differ for each investor. The Appendix includes excerpts from the indentures of several corporate and government-related green bond issuers to demonstrate the variety of projects funded and language used when issuers lay out key elements of the GBPs (Figure A-1). Since there is no market-wide standardization, many issuers choose to undergo an independent review as part of the issuance process, in which service providers such as CICERO, DNV GL, and Sustainalytics offer second-party opinions on the proposed use of proceeds, ring-fencing procedure, etc. About 60% of total green bond issuance to date has incorporated a second-party review, and this percentage has remained stable over the past three years. Interestingly, the quality of post-issuance impact reporting has become a key differentiator for the buyer base, according to some market participants. There is more investor demand for the bonds of issuers that provide high-quality information about the environmental benefits of the underwritten projects.

FIGURE 11

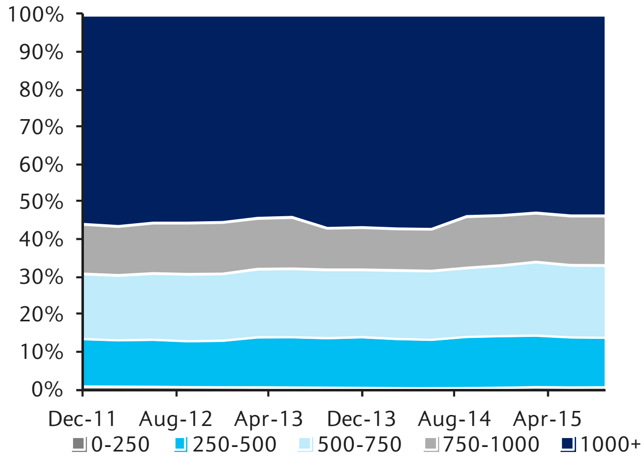
Yield and Duration of Benchmark Credit Indices



Note: Bubble sizes represent amounts outstanding in the indices. Source: Barclays Research

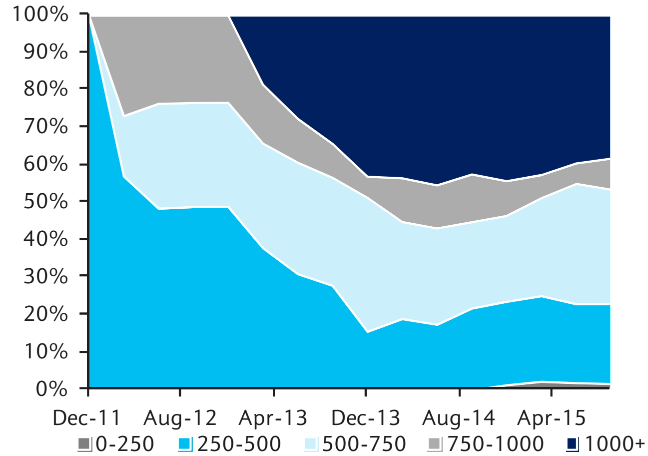
Along with guidelines such as the GBP, several green bond indices have been created to help formalize what qualifies as green. The Barclays-MSCI Green Bond Index was launched last November, and its eligibility criteria reflect the guidelines established by the GBP. There are additional qualifications for index inclusion, including specifics about the use of proceeds, which are described in *The Green Bond Index Guide*. The evaluations of green bonds by MSCI ESG Research are rigorous, with the result that some issues labeled green bonds by the issuers do not qualify for the index. This is typically due to details about the use of proceeds (see *Technical Note – Barclays MSCI Green Bond Index: September Rebalancing* for specifics on the latest review process). Because of this, as well as more general index rules regarding factors such as issue size, the index is smaller than the "labeled" green bond universe cited more generally. The Barclays Global Green Bond Index currently comprises $47bn of bonds, which increases to $51bn when high yield issuers are included.

FIGURE 12
Global Credit Index Distribution by Par Size



Source: Barclays Research

FIGURE 13
Green Bond Distribution by Par Size



Note: Chart shows custom green bond index that combines the Global Green Bond universe with high yield green bonds. Source: Barclays Research

Green Bond Characteristics

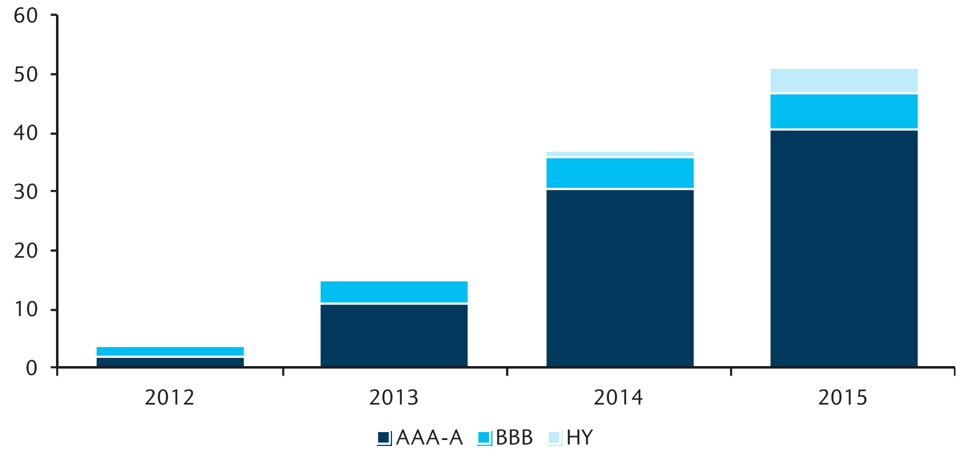
As seen in Figure 11, the green bond universe is miniscule compared with traditional indices tracked by credit investors. In addition, government-related agencies form about 60% of the green bond universe, which results in higher average credit quality and lower average yields than other credit indices. The composition of the green bond index also differs from broader indices in its typical issue size. Figures 12 and 13 compare the size distribution of the Global Credit Index with our preferred custom green bond index (the Global Green Bond Index plus high yield green bond issuers). As of month-end, about 54% of the Green Bond Index was made up of issues under $750mn, compared with just 33% of the Global Credit Index. Interestingly, the amount of small green bond issues has increased in recent quarters, suggesting that new issuers entering the market are starting small and pricing moderate green bond issues.

Part of the explanation for the trend of smaller issues is the growth of lower-rated green bond issuance. The first high yield green bond was issued by NRG Yield last August, and four other credits have entered since. Figure 14 shows the ratings distribution of the green bond universe in the past several years. High yield green bonds now form about 10% of outstanding green bonds, up from 3% at year-end 2014.

Another noteworthy distinction between green bonds and typical benchmark indices is the sector composition. More than 40% of the outstanding par of corporate green bonds has been issued by electric utility credits, compared with 7% and 3% for US investment grade and US high yield, respectively (Figure 15). The next most common sector, banking, is slightly underrepresented versus the investment grade index and overrepresented versus high yield. Looking ahead, our view is that the currently limited selection of corporate green bond sectors (the top five encompass 95% of par outstanding) underscores the vast amount of diversification in issuance that is still possible in the market.

FIGURE 14

Green Bond Ratings Distribution ($bn)

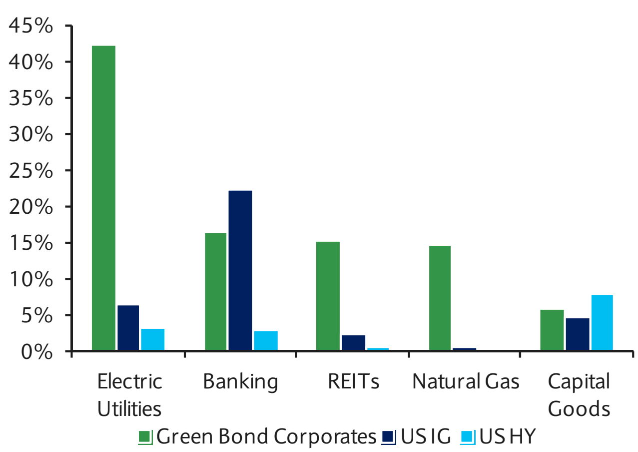


Note: Chart shows par outstanding of a custom green bond index that combines the Global Green Bond universe with high yield green bonds. Data as of September 10, 2015. Source: Barclays Research

Finally, we show the use of proceeds distribution of green bonds, as categorized by MSCI ESG Research in the Barclays/MSCI indices (Figure 16). To qualify for the green bond indices, at least 90% of proceeds must be used for either new or existing environmental projects in five broad categories: alternative energy, energy efficiency, green building, pollution prevention and control, and sustainable water. The most common category is alternative energy, which incorporates "investments in products, services, or infrastructure projects supporting the development or delivery of renewable energy and alternative fuels." Note that the categories are not mutually exclusive, so the total amount outstanding by use of proceeds exceeds that of the Global Green Bond Index.

FIGURE 15

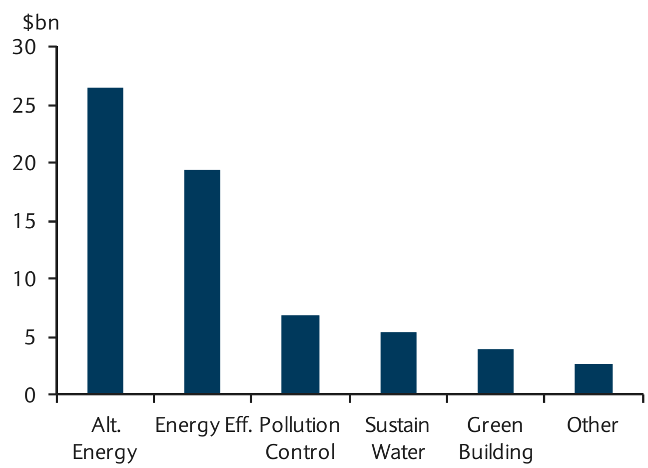
Sector Distribution of Green Bonds versus Investment Grade and High Yield Indices



Note: Custom green bond index that adds high yield issuers to Global Green Bond Index: Corporate. Data as of September 11, 2015.
Source: Barclays Research

FIGURE 16

Green Bond Environmental Use of Proceeds Distribution



Note: Data displayed are the six use of proceeds sub-indices of the Global Green Bond Index, as of September 11, 2015.
Source: Barclays Research

Growth Outlook for the Green Bond Market

The green bond market has seen steady growth and diversification since its inception less than a decade ago. We expect that the market will continue to grow beyond being a niche product:

- Tighter spreads for green bonds should encourage issuers to issue more green labeled bonds in both the corporate and municipal markets.
- Some emerging market nations have made specific commitments to entering the market. For instance, the Chinese government has made public announcements regarding its commitment to environmental causes and the need for significant investment in renewable projects. The PBOC Green Finance Task Force and UNEP released a report, *Establishing China's Green Financial System*, in April 2015 that laid out a detailed plan that stresses the development of a green bond market. Indian Prime Minister Modi has outlined a particular focus on solar growth, with a goal of $100bn in private investment and governmental support for the green bond market. The first Indian green bond was issued earlier this year by Yes Bank, a commercial bank, to fund renewable energy infrastructure projects.
- In addition to the financial benefits, green bond issuers can also receive a public relations boost by showcasing their commitment to sustainability, which potentially differentiates them from competitors and burnishes their brands, especially among younger generations. Numerous consultancy polls and studies have found that millennials place a high value on social responsibility in all aspects of their lives: as consumers, as employees, and as investors. It is therefore reasonable to think that both green bond issuers and funds that offer socially responsible investing options stand to benefit. In our view, the growth of the green bond market and similar corporate initiatives will only accelerate as the millennial generation begins to control a larger share of investable funds.

Appendix

Model Specification

The full specification for the ordinary least squares (OLS) regression is shown below, for bond *i* at time *t*.

$$OAS_{it} = \alpha_t + \beta_1(WARF_{it}) + \beta_2(OASD_{it}) + \beta_3(Issuance_{it}) + \beta_4(Currency_{it}) + \beta_5(GreenBond_{it}) + \varepsilon_{it}$$

- **Issuance:** Categorical variable for the quartile of years since issuance (first quartile omitted)
- **Currency:** Binary variable that equals zero if currency is USD, one otherwise
- **Green Bond:** Binary variable that equals one if issue is a green bond, zero otherwise

To confirm the robustness of our model, we ran several goodness-of-fit tests, which confirmed that the predictor variables do not suffer from multicollinearity. The variance inflation factor (VIF), a common test of multicollinearity that involves regressing each factor on the rest of the independent variables and then calculating each new model fit, was well below levels that warrant concern.

FIGURE A-1

Eligible Projects and Tracking Methodologies Vary Among Green Bond Issuers

	European Investment Bank	Bank of America	Vornado Realty
Use of Proceeds	Within its climate action financing framework, the EIB strongly supports energy efficiency and renewable energy investments. The bank thus contributes to the climate change and energy sustainability objectives set out by the European Union.	Proceeds will be used to fund renewable energy and energy efficiency projects in whole or in part, as defined by our internal investment criteria.	Proceeds will be used to fully or partially fund the development and redevelopment of eligible green projects.
Eligible Projects	Lending projects in the fields of renewable energy and energy efficiency include, but are not limited to: - renewable energy projects such as wind, hydro, solar, and geothermal production; and -energy efficiency projects such as district heating, co-generation, building insulation, energy loss reduction in transmission and distribution, and equipment replacement	-Renewable energy projects include financing of, or investments in, equipment and systems that facilitate the use of energy from renewable sources, such as solar, wind, and geothermal energy. -Energy efficiency projects help reduce energy consumption per unit of output and include projects such as lighting retrofits, district heating, co-generation, and building insulation in residential, commercial, and public properties.	-All new building developments that have received or are expected to receive LEED Silver, Gold, or Platinum certification. -All existing building redevelopments and all tenant improvement projects funded by us that have received, or are expected to receive, any LEED certification level. -All capital projects, executed in a manner that is consistent with Vornado's sustainability policies and that enhance energy efficiency at buildings currently LEED certified at any level. -All capital projects at buildings that are not yet certified by LEED but that improve, based on a third-party engineering study, the operating and energy efficiency of a building by a meaningful amount.
Tracking	Net proceeds will be allocated within treasury to a sub-portfolio. The balance of this will be reduced, at the end of each quarter, by amounts matching disbursements made during the quarter to lending projects within the fields of renewable energy and energy efficiency.	Our internal records will show, at any time, the net proceeds from the issuance of the notes as allocated to the assets that meet our internal investment criteria of eligible green projects.	Internal records will show the allocation of the net proceeds of this offering to eligible green projects.
Assurance	The above are merely current targets. Revisions of such targets will not be notified to bondholders. No undertaking is given that such targets will be met.	Will provide periodic updates regarding the allocation of the net proceeds of the notes to eligible green projects, detailing the projects funded, current funded amounts, initial funding dates and contractual maturity dates, and assertions by management that the net proceeds of the notes are invested in qualifying eligible green projects. The updates and assertions will be accompanied by a report from an independent accountant.	Will publish annual updates on a dedicated page of the website (within one year of issuance) detailing, at a minimum, the allocation of the net proceeds of the notes to eligible green projects. Updates will be accompanied by an assertion by management that the net proceeds were invested in qualifying projects and a report from an independent accountant.

Note: Includes paraphrased language from company filings. Source: Company filings, Barclays Research.

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