

From Grass to Mass: An Index-Based Approach to Measuring Greenium in Green Bonds

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EXECUTIVE SUMMARY

- Green bonds have historically exhibited a green premium—or “greenium”—meaning they have lower yields compared to non-green bonds with otherwise similar characteristics.
- Rapid growth and increasing differentiation within the green bond market has led to better ways to measure greenium across global bond markets.
- An index-based approach illustrates the level of greenium across bond markets; comparing current levels to historical ones suggests shrinking greenium in many major markets.

INTRODUCTION

Green bonds are tied to specific environmentally friendly projects of an issuer. The borrower agrees that the use of proceeds will be invested in environmentally friendly projects such as alternative clean energy, low carbon assets (e.g., green buildings, factories, or vehicles), or sustainable usage of water, pollution, or natural resources. In exchange for this commitment, the issuer seeks economic benefit in the form of a lower borrowing cost. First tapped by supranational borrowers such as the European Investment Bank and the World Bank, the index market value of green bonds surpassed USD 1 trillion in September 2021,¹ expanding from sovereign and quasi-sovereign bonds to corporate and securitized debt.

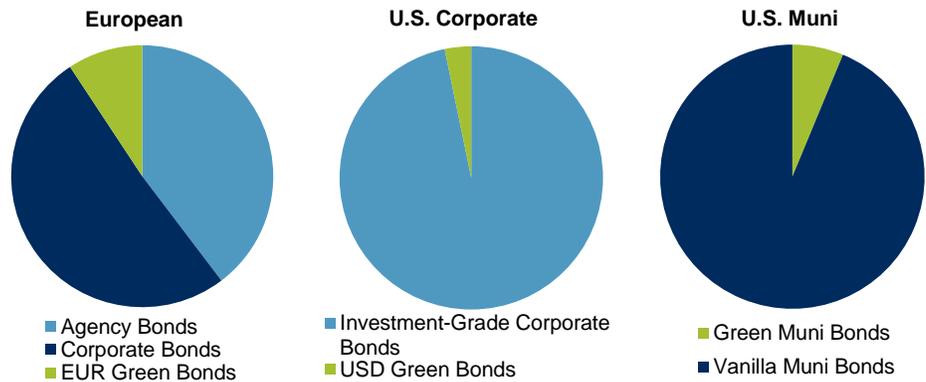
The green bond market, as measured by the [S&P Green Bond Index](#), has grown since its 2007 debut: growth in the market value of green bonds averaged 70% annually over the past decade, compared with 3% for the global bond market² (see Exhibit 1). Along with surging growth, investor demand for green bonds has remained strong.

¹ Par value outstanding for the S&P Green Bond Index.

² Based on the annual market value growth rate compounded annually for the S&P Green Bond Index and the [S&P Global Developed Aggregate Ex-Collateralized Bond Index](#) from May 31, 2012 to May 31, 2021.

Exhibit 1: Green Bonds across Select Markets:

Green bonds are tied to specific environmentally friendly projects of an issuer.



Source: S&P Dow Jones Indices LLC. Data as of October 2021. Charts are provided for illustrative purposes.

Growth in the market value of green bonds averaged 70% annually over the past decade, compared with 3% for the global bond market.

S&P Global Ratings’ research on the European credit market observed initial sustainable bond yields to be lower compared with conventional bonds,³ incentivizing issuers. Despite a lower yield, or greenium, investors absorbed the liquidity of green bonds, further stimulating supply. In cases of no greenium at issuance, the research highlighted economic incentives for the investor in the form of outperformance. Tracking historical performance of two nearly identical German government bunds demonstrated additional spread tightening of 5 bps of the bund that was classified as green⁴ in the year since issuance (see Exhibit 2).

Historical pricing appeared to demonstrate a price premium for green over non-green, or vanilla, bonds, as green debt represents just 2% of the overall market. More recent evidence suggests mutual benefits for investors and issuers alike as green and vanilla bond yields converge over time. This paper analyzes factors contributing to the changing relative valuation between green and vanilla bonds. Markets covered include European government agency and corporate bonds, as well as U.S. corporate and municipal markets.

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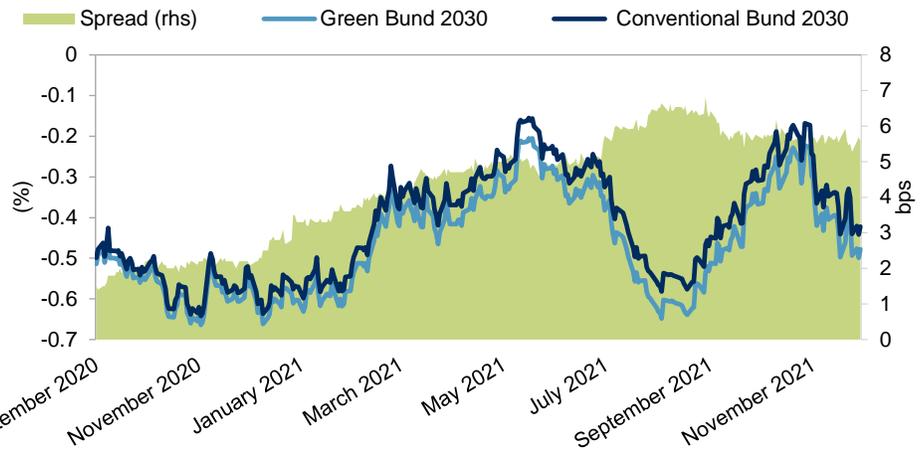
Many issuers have repeatedly tapped the green bond market, allowing for issuer-based credit curves. In select cases, they provide good comparisons, but this is rare. Often, new green bonds cannibalize matured vanilla bonds, creating new issue bias. Applying a comprehensive credit valuation approach, this paper analyzes green and vanilla bonds by issuer, sector, and credit rating.

³ Byrne, Patrick Drury, and Sandeep Chana. 2021. “[Green Liquidity Moves Mainstream.](#)” S&P Global Ratings.

⁴ Pastor, Lubos, Robert F. Stambaugh, and Lucian A. Taylor. 2021. “[Dissecting Green Returns.](#)” Jacobs Levy Equity Management Center for Quantitative Financial Research.

Exhibit 2: German Bunds – Green Compared with Conventional

Initial demand for green bonds came from a small group of Scandinavian pension funds seeking an investment that incorporated the UN’s warning on climate change.



Source: S&P Global Market Intelligence. Data as of October 2021. Past performance is no guarantee of future results. Chart is provided for illustrative purposes.

GREEN BONDS HAVE TAKEN ROOT AND THE MARKET IS MATURING

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Initial demand for green bonds came from a small group of Scandinavian pension funds seeking an investment that incorporated the UN’s warning on climate change. Today that demand also comes from the world’s largest asset managers and asset owners. The world’s largest asset owner, Japan’s Government Pension Investment Fund (GPIF), now requires asset managers to integrate environmental, social, and governance (ESG) principles and singles out green bonds as a direct method for fixed income investors.⁵ BlackRock, the world’s largest asset manager, believes pursuing a net zero investment strategy is part of its fiduciary duty.⁶ The largest economies in Asia and Europe have pledged net zero commitments and the U.S. has rejoined the Paris Agreement. As the largest governments, and by extension the largest borrowers, try to shift toward sustainability, so have their debt profiles. Significant parts of the private sector have followed as well. The largest corporate borrowers in the green bond market are energy, infrastructure, and financing companies.

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While large investors and countries are now embracing green bonds, this was not always the case. In 2018, GPIF’s CIO called green bonds a “lose-lose product” due to the costs associated with issuance and a lower liquidity profile.⁷ Academic research during that period observed a greenium of 15-

⁵ Comments from CIO of GPIF on March 24, 2020. <https://www.gpif.go.jp/en/investment/esg/kfw.html>

⁶ BlackRock’s 2021 letter to shareholders. <https://www.blackrock.com/us/individual/2021-blackrock-client-letter>

⁷ Laidlaw, Jennifer. Nov. 27, 2018. “Green bonds are ‘lose-lose product,’ says Japan’s GPIC exec.” <https://www.spglobal.com/marketintelligence/en/news-insights/trending/1ogftjbermtc6a0efqmeccg2>

Recent studies are no longer finding steep premiums for green bonds and reporting little to no difference in greenium.

30 bps,⁸ a significant benefit for issuers at the cost of market participants pursuing ESG investments. More recent studies are no longer finding such steep premiums⁹ and reporting little to no difference in greenium. Reasons for such divergence in findings is largely due to small sample size, disparities among sectors of the bond market, and difficulty of finding truly comparable bonds. As the market matures, working with transparent rules-based indices alleviates many of these challenges.

SAILING THE SEVEN Cs: CREDIT ANALYSIS AND CREDIT CURVE CONSTRUCTION

Quantifying greenium requires building a credit curve of similar bond issuances and measuring the difference. To some extent, such differences may be detected by credit ratings, but further differences can be important, particularly for bonds from different issuers. Fundamental credit analysis typically evaluates bonds based on four Cs: capacity, collateral, covenants, and character.¹⁰ Using these measures within the S&P Global Bond Indices, a controlled subset of green and vanilla bonds may be created for purposes of apples-to-apples comparisons in sectors where data is sufficient for statistically significant results. The European banking and energy sectors provide two examples with sufficiently broad data over a long historical period, but as green issuance has grown, other sectors—such as the U.S. municipal bond market—have become suitable arenas of study.

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On top of the four Cs of fundamental analysis are three more: credit curve construction, which results in a measure of a bond's return relative to time to maturity. Yield-to-maturity measures the return over the life of the bond, absent a default. Adjusting for the risk-free rate of return of a sovereign yield curve, the option-adjusted spread (OAS) measures the issues' incremental return offered. The risk—including the risk of default—grows with the length of time before the money is paid, and is frequently measured by the effective duration or interest rate sensitivity of a particular bond. When plotting bonds by OAS and duration, a typical environment would show an upward sloping curve, indicating an increase in yield, or OAS, demanded for each unit of duration risk.

Lastly, the greenium analysis considers market accessibility, liquidity, and other factors that affect demand. One way to account for that is by using

⁸ Hachenberg, Britta, and Dirk Schiereck. 2018. "Are green bonds priced differently from conventional bonds?" *Journal of Asset Management*.

Gianfrate, Gianfranco, and Mattia Peri. 2019. "The green advantage: Exploring the convenience of issuing green bonds." *Journal of Cleaner Production* 219: 127–35.

Kapraun, Julia, and Christopher Scheins. 2019. "(In)-Credibly Green: Which Bonds Trade at a Green Bond Premium?" Working Paper. Frankfurt: Goethe Universität Frankfurt.

⁹ Larcker, David F., and Edward M. Watts. 2020. "[Where's the greenium?](#)" *Journal of Accounting and Economics* 6: 101312.

¹⁰ Gootkind, Christopher L. "[Fundamentals of Credit Analysis](#)." 2022 CFA Program, Level I, Reading 4. 4

Indices greatly simplify the exercise by grouping bonds with similar characteristics into comparable cohorts.

broad market benchmarks to measure the returns of a particular bond market. Indices greatly simplify the exercise by grouping bonds with similar characteristics into comparable cohorts. As an example of this process, the [S&P Eurozone Investment Grade Corporate Bond Index](#) only includes bonds with similar debt features (e.g., minimum amount outstanding, fixed rate, and denominated in euros). The largest issuers in the index are then selected and matched up if those issuers have at least four bonds that qualify for the S&P Green Bond Index. In addition to similar index rules applied in the S&P Eurozone Investment Grade Corporate Bond Index, the S&P Green Bond Index requires eligible instruments to be labeled as green by the issuer and tracked by the Climate Bonds Initiative.¹¹

MEASURING GREENIUM ACROSS GLOBAL GREEN BOND INDICES

Our analysis focuses on quasi-government bonds, euro- and U.S. dollar-denominated corporates, and U.S. municipal bonds.

This analysis explores green and vanilla bonds with similar profiles. Our first analysis focuses on euro-denominated issuer curves of quasi-government bonds. The analysis broadens its sample size by isolating issuers with similar credit ratings. This same approach is then taken for euro-denominated corporates, then U.S. dollar-denominated corporates, and lastly U.S. municipal bonds. Each market reveals how the growth of green bonds has shaped issuer trends as well as differences in credit spreads over time.

Differences in spreads are the tightest across all bond markets globally, ranging between 1 and 3 bps. One possible explanation would be the corporate purpose of the issuers. Quasi-government institutions in this sample are closely aligned with ESG principles, scoring high across several ESG standards. The corporate bond market, which includes several energy companies active in the green market, should offer a stark contrast.

Quasi-government bond indices include a healthy amount of governmental green debt outstanding. Governmental development banks like Kreditanstalt für Wiederaufbau (KfW), European Investment Bank (EIB), and North Rhine-Westphalia Bank (NRW) were early issuers to tap the green bond market, and they currently top green bond issuance.

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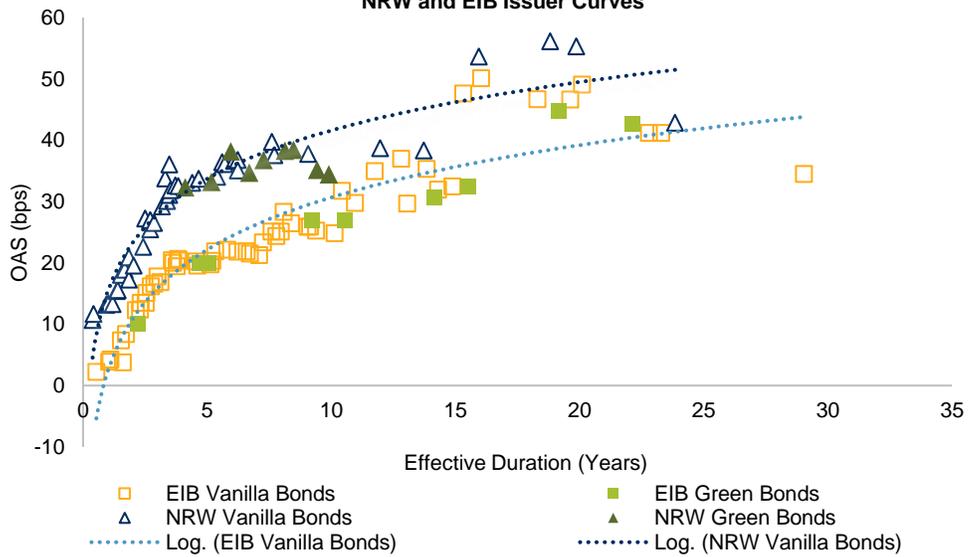
These three issuers have five or more outstanding green bonds eligible in the [S&P Eurozone Quasi & Foreign Government Bond Index](#). Plotting those alongside 40-50 of their vanilla bonds shows a tight alignment with a robust credit curve. In each of the issuer's cases, the green bonds fell within a tight range of vanilla bonds. To further expand the analysis, we calculated the average greenium of vanilla and green bonds with similar effective durations. KfW and EIB both showed a declining average greenium of 2-4 bps over the past two years, while NRW's average greenium hovered around 1 bp.

¹¹ Only bonds with 100% use of net proceeds are included. Social bonds are not included and only bonds that are aligned with the [Climate Bonds Taxonomy](#) are included.

Exhibit 3: Issuer Curves and Green Bond Issuance

NRW and EIB Issuer Curves

In each of the issuer's cases, the green bonds fell within a tight range of vanilla bonds.



YEAR	KFW		NRW		EIB	
	NUMBER OF BONDS	AVERAGE GREENIUM	NUMBER OF BONDS	AVERAGE GREENIUM	NUMBER OF BONDS	AVERAGE GREENIUM
2021	6	0	9	-1	9	-2
2020	5	-1	7	0	8	-3
2019	5	-3	5	1	8	-4

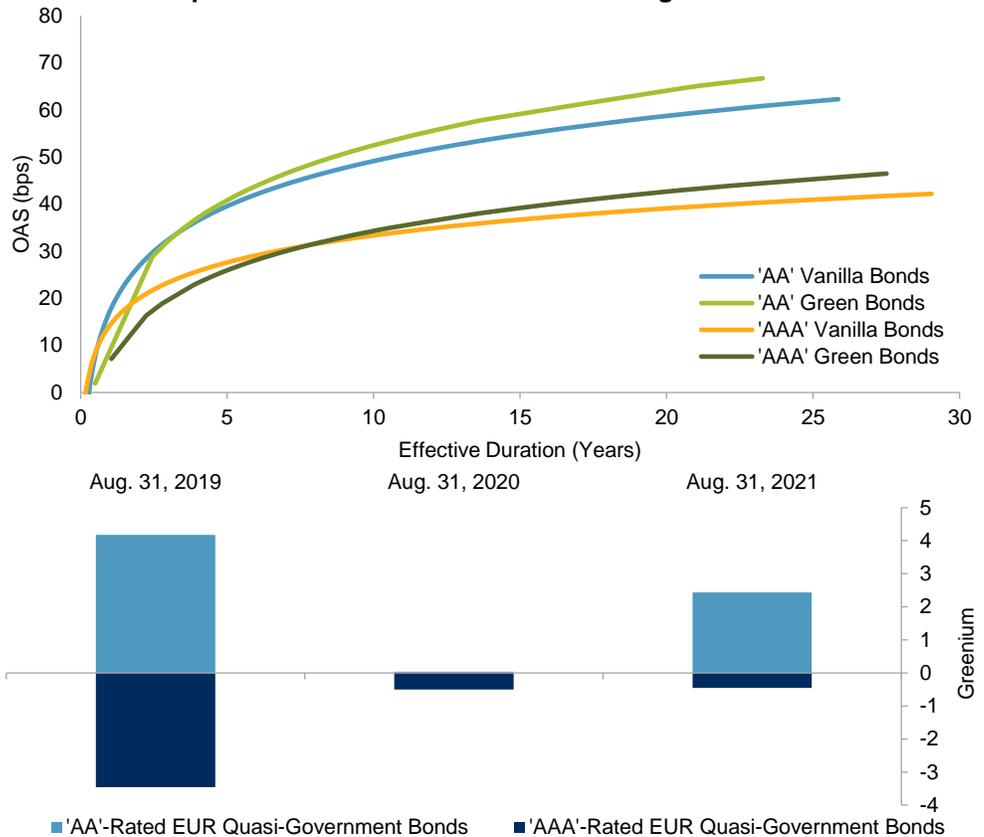
Source: S&P Dow Jones Indices LLC. Data as of Aug. 31, 2021. Chart and table are provided for illustrative purposes.

The logarithmic trendline of green and vanilla bonds showed declining greenium for shorter-dated bonds, while greenium increased for longer-dated bonds.

Expanding the analysis to 'AAA'- and 'AA'-rated issuers active in both green and vanilla markets increased the relevant sample to over 30 green bonds in each credit bucket. The logarithmic trendline of green and vanilla bonds showed declining greenium for shorter-dated bonds, while greenium increased for longer-dated bonds.

Exhibit 4: European Quasi-Government Credit Rating Curves

When it comes to for-profit entities, European energy companies were among the first corporations to tap the green bond market.



Source: S&P Dow Jones Indices LLC. Data as of Aug. 31, 2021. Curve represents the logarithmic trendline of green bond issuers and their respective vanilla issuers. Charts are provided for illustrative purposes.

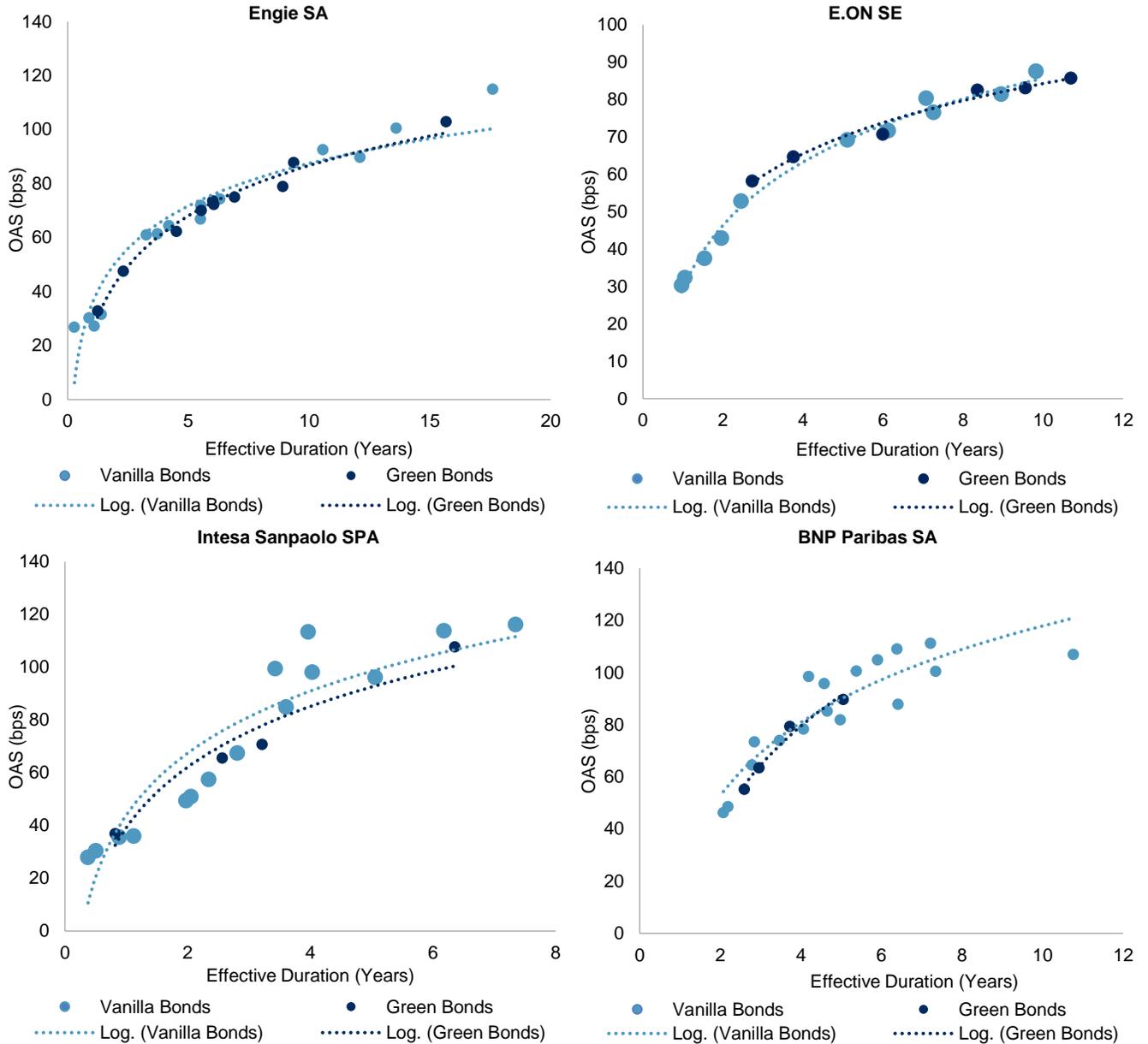
When it comes to for-profit entities, European energy companies were among the first corporations to tap the green bond market. Engie and E.ON are the two of the largest energy bond issuers in the market (Tennet also ranks highly, but no longer issues enough vanilla bonds to assess greenium).

Greenium across all European utility bonds increased on average from 5 to 9 bps

Evaluating the corporate curve of these two issuers provides similar results. Engie’s green curve demonstrates premiums from August 2020. That premium narrowed by 5 bps to the current greenium of only 2 bps across the curve. In the case of E.ON, the curve (consisting of six green bonds) has tightened from August 2020, and shows a slight discount to the lower duration vanilla bonds.

Greenium across all European utility bonds increased on average from 5 to 9 bps. Using the two issuers from the banking sector and including similarly rated, senior non-preferred bonds, we constructed curves for BNP Paribas and Intesa Sanpaolo. This further restricted the universe of eligible securities but presents the closest comparison from a seniority ranking perspective. Intesa Sanpaolo and BNP Paribas each only had three eligible green bonds last year. The lack of a true comparison highlights the difficulty in assessing greenium across an issuer.

Exhibit 5: Issuer Credit Curves



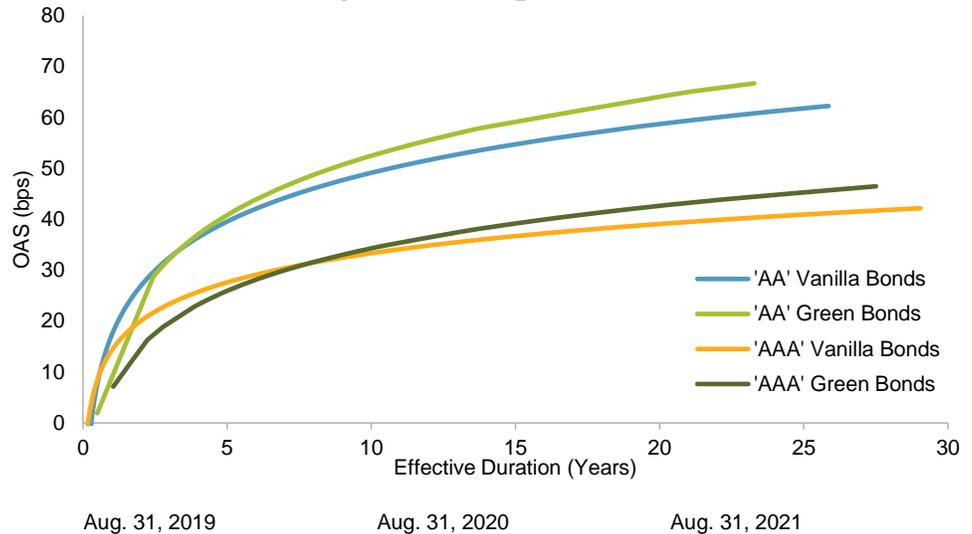
DATE	INTESA SANPAOLO		BNP PARIBAS SA		E.ON SE		ENGIE SA	
	NUMBER OF BONDS	AVERAGE GREENIUM (BPS)						
Aug. 31, 2021	4	-6	4	-3	6	1	10	-2
Aug. 31, 2020	3	-7	3	-3	5	-2	8	-7

Source: S&P Dow Jones Indices LLC. Data as of Aug. 31, 2021. Curve represents the logarithmic trendline each issuer. Charts and table are provided for illustrative purposes.

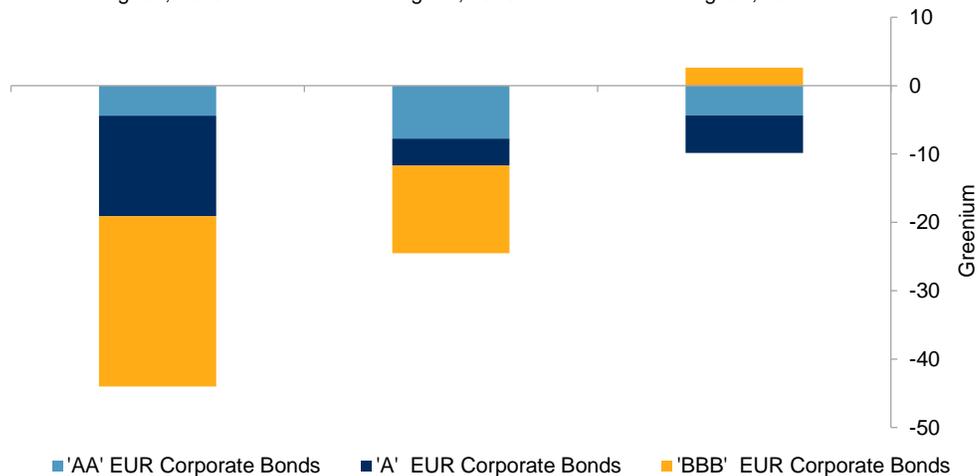
Next, we analyzed select credit sectors in the S&P Eurozone Investment Grade Corporate Bond Index. Evidence of a greenium across 'A' and 'AA' bonds is apparent, showing the lower yield offered by green bonds. Compared with August 2019, greenium has significantly declined across all three ratings, with 'BBB' bonds going from having the largest greenium (25 bps) to a mere 3 bps.

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Exhibit 6: EUR Greenium by Credit Rating



...with 'BBB' bonds going from having the largest greenium (25 bps) to a mere 3 bps.



Source: S&P Dow Jones Indices LLC. Data as of Aug. 31, 2021. Curve represents the logarithmic trendline of green bond issuers and their respective vanilla issuers. Charts are provided for illustrative purposes.

When it comes to the U.S. corporate bond market, few green bonds qualify. Only about 100 green bonds of the 8,600 bonds qualify for the S&P U.S. Investment Grade Corporate Bond Index. Further narrowing the list to those with issuance in both green and vanilla markets results in only one issuer, MidAmerican Energy Company, to build a curve using at least five eligible green and vanilla bonds.

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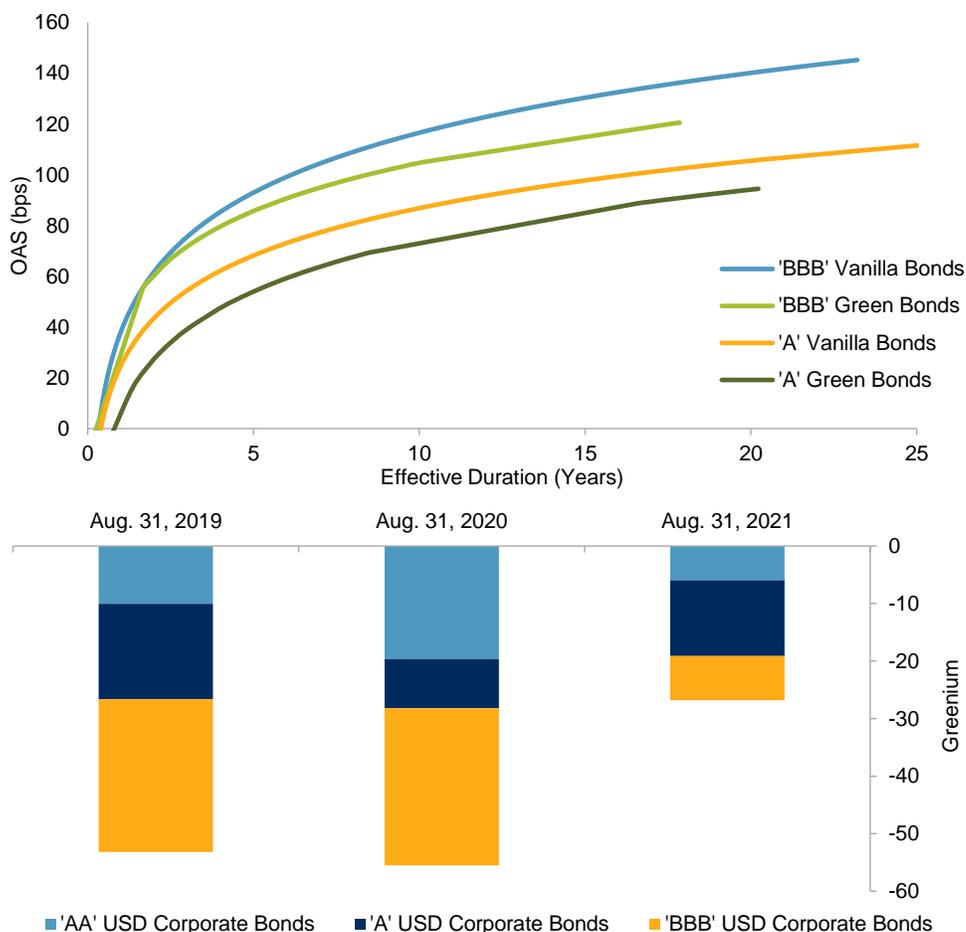
Expanding to similarly rated corporate bonds creates a sufficient sample for analysis, with 'A'- and 'BBB'-rated issuers providing 41 and 50 bonds,

With nearly triple the observations, European green bonds trade much tighter than their U.S. counterparts.

respectively. Comparing those with the vanilla sectors produced consistent results. 'BBB'- and 'A'-rated green bonds demonstrated an average greenium of 8 and 13 bps, respectively, which are the largest green premia observed globally.

With nearly triple the observations, European green bonds trade much tighter than their U.S. counterparts. In 2019, the size of the European green bond market was about 100 green bonds, similar to recent issuance outstanding in the U.S. The greenium in the European market has shrunk to one-half the premium observed in 2019. This suggests that increased global issuance and broader adoption may have led to further convergence over time.

Exhibit 7: USD Corporate Greenium by Credit Rating



The greenium in the European market has shrunk to one-half the premium observed in 2019.

The USD corporate utilities sector is one area with sufficient industry representation.

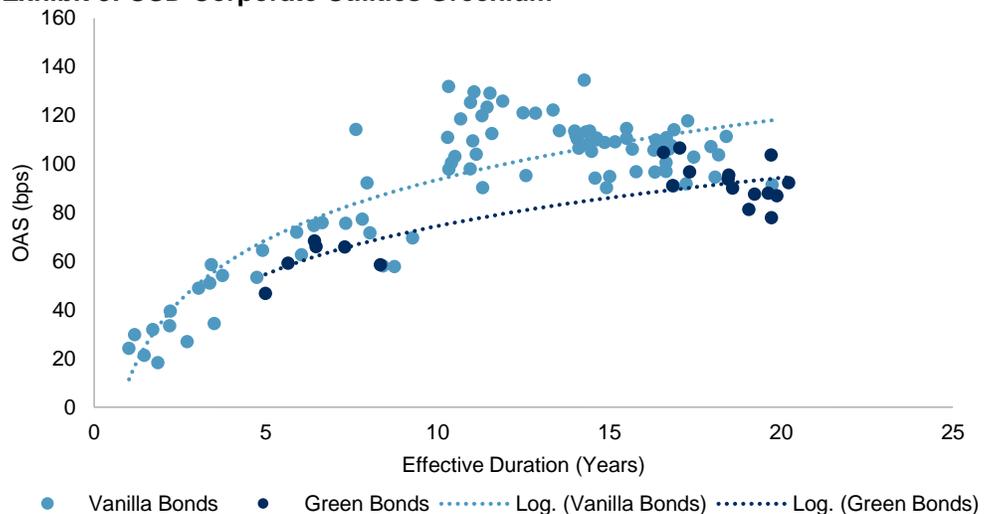
Source: S&P Dow Jones Indices LLC. Data as of Aug. 31, 2021. Curve represents the logarithmic trendline of green bond issuers and their respective vanilla issuers. Charts are provided for illustrative purposes.

The USD corporate utilities sector is one area with sufficient industry representation. It also produces the tightest fit between green and vanilla bonds. With 26 unique issuers and 47 green bonds, the sample is large and diversified enough to assess greenium. The energy sector also provides a clear demonstration of the environmental impact of the use of

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proceeds, with green bonds focusing on a lower environmental impact relative to vanilla energy issuances. This contrasts with the quasi-government and financial sectors, which are identified as low-carbon-emitting sectors.

Exhibit 8: USD Corporate Utilities Greenium



Source: S&P Dow Jones Indices LLC. Data as of Aug. 31, 2021. Charts are provided for illustrative purposes.

...with green bonds focusing on a lower environmental impact relative to vanilla energy issuances.

Last, we look at the greenium in the tax-exempt municipal bond market, revealing structural shifts by large green issuers. Using the [S&P U.S. Green Municipal Bond Index](#) and the [S&P National AMT-Free Municipal Bond Index](#), we start with a much larger pool of 3,000 and 12,800 bonds, respectively.

The S&P National AMT-Free Municipal Bond Index is designed to measure the performance of the largest municipal bonds not subject to alternative minimum tax. The index includes 383 bonds that are also eligible for the S&P U.S. Green Bond Index, including the largest green municipal issuer, the New York Metropolitan Transportation Authority (NY MTA) with 111 individual cusips. The sector mix has over 30 general obligation bonds, and the largest segment includes transportation with 118 bonds and utilities with 72. Other sectors included in the analysis are taxable revenue, schools, education, and buildings.

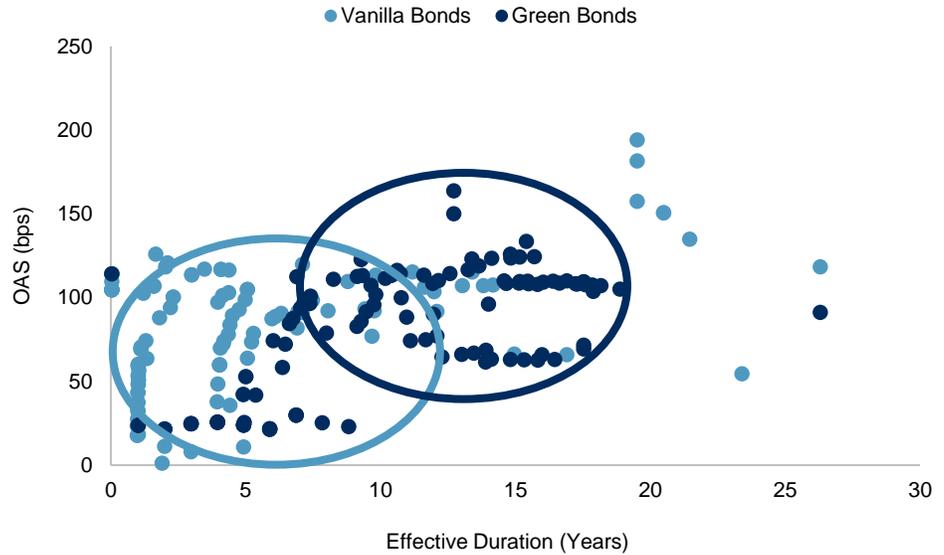
The greenium in the tax-exempt municipal bond market reveals structural shifts by large green issuers.

Constructing a credit curve of over 100 green and vanilla bonds should present a fair comparison, but instead it highlights a shift in issuers' preference. The NY MTA issued green bonds at a rate of five times that of vanilla bonds. This change in issuance type, demonstrated by older/shorter-dated vanilla bonds on the left hand side of the scatter plot in Exhibit 9 and many newer/longer-dated green bonds on the right hand side, highlights the shift in issuance structure. We see a similar trend with the Los Angeles MTA issuer curve, confirming the presence may extend to the entire transportation sector.

Comparing green and vanilla bonds in the transportation sector shows consistent greenium for bonds with durations longer than five years (see Exhibit 10).

Exhibit 9: NY MTA Issuer Curve Reflects Move to Green

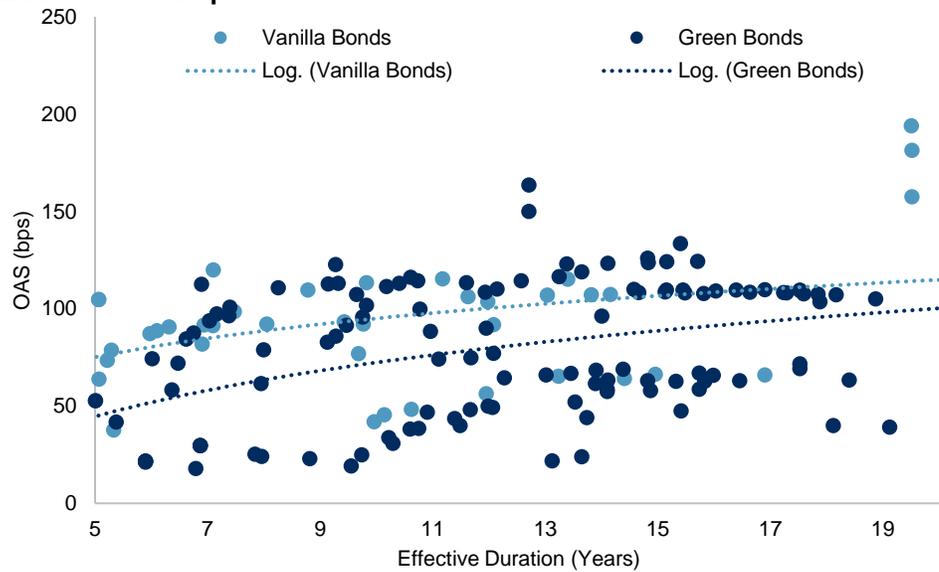
Comparing green and vanilla bonds in the transportation sector shows consistent greenium for bonds with durations longer than five years.



Source: S&P Dow Jones Indices LLC. Data as of Oct 29, 2021. Chart is provided for illustrative purposes.

Exhibit 10: Transportation Issuer Curve

The utilities sector has broad issuer and geographic representation, with 17 issuers and 9 states in the index.

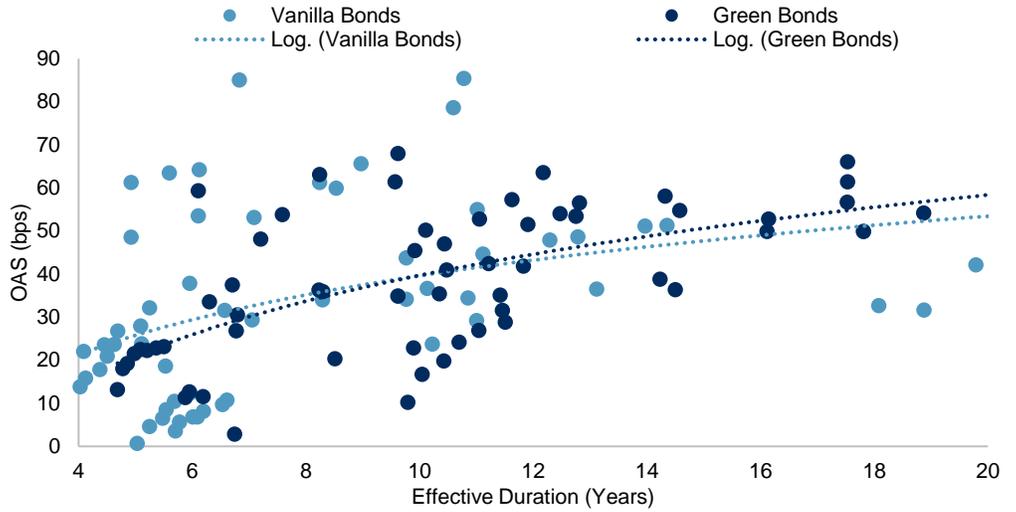


Source: S&P Dow Jones Indices LLC. Data as of Oct. 29, 2021. Chart is provided for illustrative purposes.

The transportation and utilities sectors combined have 225 green bonds in the S&P National AMT-Free Municipal Bond Index, although securities are heavily dominated by the NY MTA (111). The utilities sector has broad issuer and geographic representation, with green and vanilla bonds outstanding by 12 issuers in 11 states.

Exhibit 11: Municipal Utilities Issuer Curve and Average Greenium

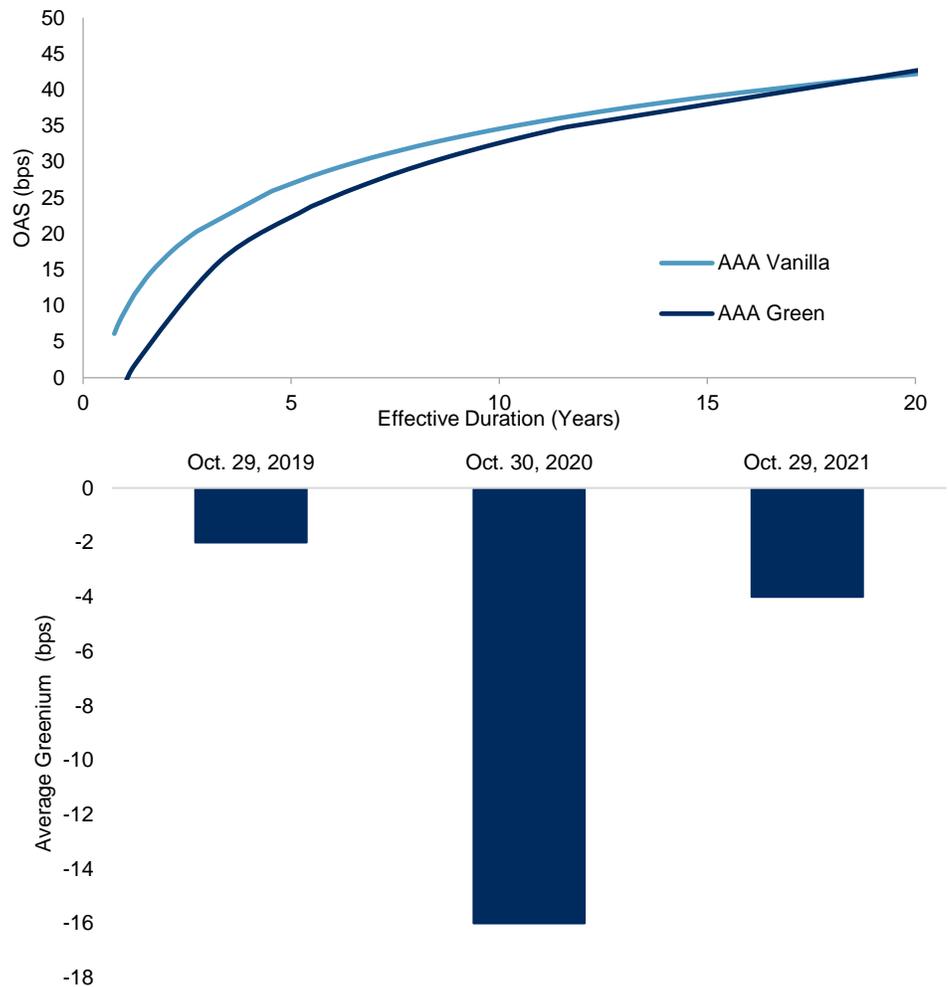
The growth of the green bond market in recent years has come despite green bonds exhibiting lower yields than their vanilla counterparts.



Source: S&P Dow Jones Indices LLC. Data as of Oct. 29, 2021. Chart is provided for illustrative purposes.

Exhibit 12: Municipal AAA-Rated Average Greenium

Today, the largest number of green bond issuances come from U.S. municipalities.



Source: S&P Dow Jones Indices LLC. Data as of Oct. 29, 2021. Charts are provided for illustrative purposes.

CONCLUSION

While premiums broadly exist in today's green bond markets, shifting issuer and investor preference will likely play a large role in how the market evolves.

The growth of the green bond market in recent years has come despite green bonds exhibiting lower yields than their vanilla counterparts. Green bonds have grown from isolated government and European issuers to global issuers in multiple currencies. Today, the largest number of green bond issuances come from U.S. municipalities. Segments like infrastructure are almost completely migrating to green debt, while banking and financial institutions are finding opportunities to attract a new investor base. The market has surpassed USD 1 trillion in outstanding debt, still a tiny fraction of total debt outstanding. Rising government deficits and historically low yields will presumably continue to drive issuance of debt, including green bonds. While premiums broadly exist in today's green bond markets, shifting issuer and investor preference will likely play a large role in how the market evolves.

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