Green Bond Performance Primer

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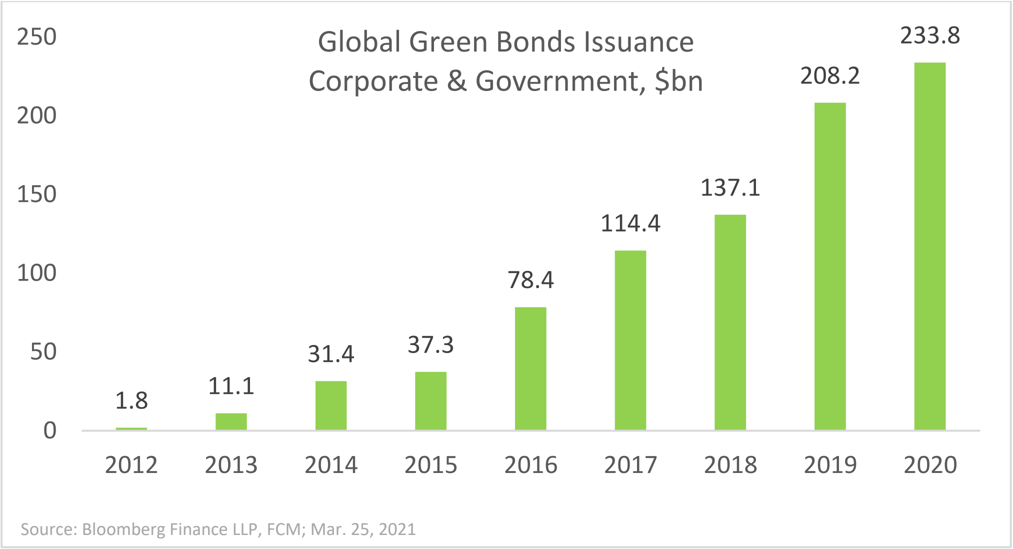
Ilya Perlovsky, CFA, FCM Market Strategist
Thomas DeMarco, CFA, FCM Market Strategist

Summary

The focus of this paper is to compare the performance of green bonds to the broad market using global bond indices, as well as to compare the performance of tax-exempt municipal green bonds to taxable U.S. dollar green bonds. We also attempt to quantify the benefits to going green by comparing new issue pricing and subsequent performance of issuer-labeled municipal green bonds to conventional bonds from the same issuer. Preceding the performance analysis are highlights of market growth, the development of market standards, and index eligibility.



Market Standard

Growth of the green bond market has imposed the need for broadly accepted guidelines for both issuers and investors. According to the Climate Bonds Initiative (CBI), green bond issuance aligned with its definitions was $45 billion in 2015, $157 billion in 2016, $171 billion in 2018, $257 billion in 2019, and $290 billion in 2020. Excluded from these totals are billions of dollars more of labelled green bond issuance not aligned with CBI definitions.

An important step in the development of the market was a set of Green Bond Principles (GBP) agreed to by a consortium of banks that furnished standards against which investors may assess green credentials of labelled issuance.

There is a strong investor preference for green bonds to be assessed independently from issuers. Benchmark indices from the Bloomberg Barclays MSCI Green Bond Index family and from S&P Dow Jones Indices are another important step toward transparency and market standardization, providing investors with the means to evaluate performance and assess risk. MSCI ESG Research determines index eligibility for the Bloomberg indices and reflects central tenets of GBP, while S&P Green Bond Indices rely on CBI criteria to determine index eligibility.

Nevertheless, "green-washing" by some issuers pushes the boundaries of what may be acceptability considered a green use of proceeds and continues to strain market credibility. As the market continues to grow, issuer self-labeling practices that push the limits of reasonableness may become a smaller concern.

Index Eligibility

For inclusion in the Bloomberg Barclays MSCI Global Green Bond Index both self-labeled green bonds and unlabeled bonds are evaluated using stated criteria. Bonds that fund projects which comply with an eligible MSCI Green Bond category and where the issuer provides sufficient transparency on the use of proceeds can be considered for the index even if it is not explicitly marketed as green. Once defined as green, further eligibility rules are applied that require all bonds to comply with Bloomberg Barclays Global Aggregate Index criteria. While the Bloomberg Barclays MSCI Green Bond Index allows for multiple sub-indices defined by sector, credit quality, region, currency, maturity, use of proceeds, as well as issuer-capped indices, no municipal sub-index is available at this time despite taxable municipals being index eligible. That said, in their 2021 Municipal Benchmark Governance Review announcement, the Bloomberg Barclays index team noted among the primary topics to be considered were the development of ESG Municipal bond indices as well as the evaluation of new index candidates such as additional Municipal Taxable sub-indices (based on maturity, ratings and classifications).

For inclusion in the S&P Green Bond Index only CBI-labeled green bonds are considered, subject to additional S&P Dow Jones Indices eligibility criteria. There are several sub-indices available, including the S&P U.S. Municipal Green Bond Index designed to measure the performance of U.S. green-labeled tax-exempt municipal bonds and the S&P Green Bond U.S. Dollar Select Index designed to measure the performance of taxable bonds denominated in U.S. dollars.

Municipal Green Bond Issuance

Total issuer-labeled municipal green bond issuance (taxable and tax-exempt) comprised only 3% of total municipal bond issuance in 2020, although the proportion has grown over the past five years. Year-to-year volumes since 2014 have been variable though, ranging from a low of $3 billion in 2014 and 2018 to $10 billion in 2017 and 2019. Judging by the last three years alone, a trend to greater market acceptance may be developing. Table 1 compares municipal green bond issuance to taxable municipal issuance – another niche segment of the market – and to total issuance.

Table 1: U.S. Municipal Bond Issuance ($ billions)

Year	Total	Taxable	% of total	Green	% of total	# Issuers	# Issues
2014	$305	$22	7%	$3	1%	299	16
2015	$377	$27	7%	$4	1%	533	28
2016	$428	$28	7%	$7	2%	892	39
2017	$410	$32	8%	$10	2%	1,149	48
2018	$318	$25	8%	$3	1%	660	40
2019	$411	$69	17%	$10	2%	1,096	78
2020	$470	$142	30%	$14	3%	2,270	150

Source: Bloomberg Finance LLP, FCM; Mar. 25, 2021

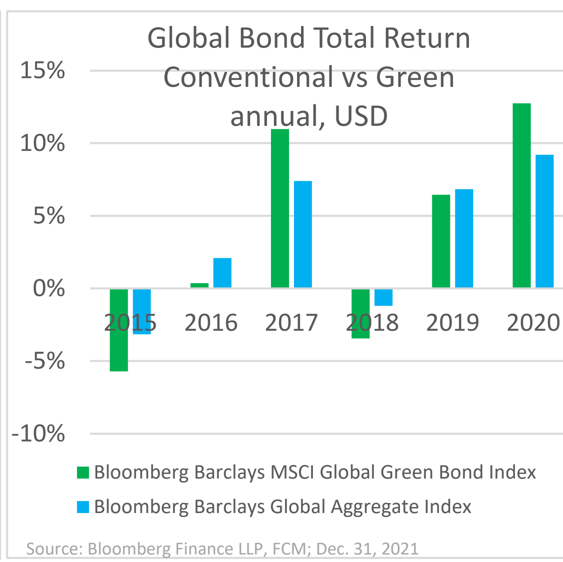
Performance

The performance of green bonds appears to track the performance of similar conventional bonds, with performance attribution differences primarily explained by characteristics such as duration, quality, and currency. In the case of the Bloomberg Barclays MSCI Global Green Bond Index performance has lagged that of the Global Aggregate Index in four of the past six years. In years the green bond index outperformed (2017, 2020) or lagged the least (2019) interest rates fell (using the 10-year U.S. Treasury as a proxy), implying greater positive convexity than the Global Aggregate Index. The correlation of annual total returns between the two indices was 0.98, while the correlation versus the change in the 10-year U.S. Treasury yield was -0.73 and -0.78, respectively. Table 2 displays index characteristics and the charts following the table show total return for the two global indices.

Table 2: Global Bond Index Characteristics

As of 03/25/2021	Bloomberg Barclays MSCI Global Green Bond Index	Bloomberg Barclays Global Aggregate Index
Yield to Worst (%)	0.55	1.11
Option-Adjusted Duration (years)	8.0	7.4
Market Value (billions)	$606	$66,088
Option-Adjusted Spread (bps)	59	34
Time to Maturity (years)	8.9	9.1
Constituents	637	26,924

Source: Bloomberg Finance LLP, FCM; March 25, 2021



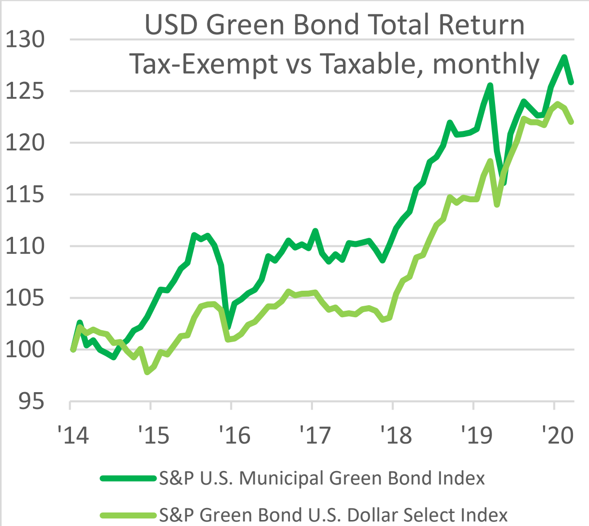
Past performance is no guarantee of future results
See "Important Additional Information" for definitions of key terms

In the U.S. dollar green bond market, index performance is more closely related to changes in U.S. rates, with the correlation versus the 10-year U.S. Treasury yield at -0.88 for the S&P Green Bond U.S. Dollar Select Index. However, the correlation is less significant at -0.62 for the S&P U.S. Municipal Green Bond Index. Likewise, the two U.S. indices don't share the closer correlation exhibited between the global indices, with the correlation of annual total returns at 0.59 over the past six years. Since 2014, the municipal green bond index cumulative total return outpaced the parent index by 311 basis points, although most of the outperformance came prior to 2019, and in 2020, the municipal green bond index underperformed by 347 basis points. The lagging performance is surprising given that the 10-year Treasury yield fell 100 basis points in 2020 and the municipal green bond index has a duration that is nearly double its taxable counterpart. We think the diverging performance relates to differences in credit and convexity between the two indices. Table 3 displays index characteristics and the charts following the table show total return for the two U.S. dollar green bond indices.

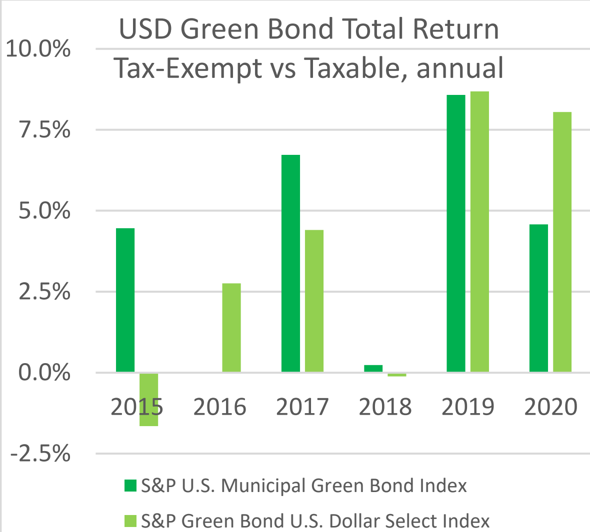
Table 3: USD Green Bond Index Characteristics

As of 03/25/2021	S&P Green Bond U.S. Dollar Select Index	S&P U.S. Municipal Green Bond Index
Yield to Worst (%)	1.92	1.43
Modified Duration (years)	5.5	10.3
Market Value (billions)	$168	$51
Option-Adjusted Spread (bps)	n/a	n/a
Time to Maturity (years)	7.4	15.2
Constituents	263	2,784

Source: Bloomberg Finance LLP, S&P Dow Jones Indices LLC, FCM; March 25, 2021



Source: Bloomberg Finance LLP, S&P Dow Jones Indices LLC, FCM; Feb. 26, 2021



Source: Bloomberg Finance LLP, S&P Dow Jones Indices LLC, FCM; Dec. 31, 2020

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Benefits to Going Green?

We ask the question from two perspectives: from the investor's in terms of relative performance and from the issuer's in terms of borrowing costs. To answer the question, we compared issuer-labeled municipal green bonds to conventional bonds from the same issuer, controlling for security type, tax status, coupon, call date, and maturity. Specifically, our approach measured the issue spread of each bond as well as how the spread performed from the dated date through 31 December 2020. <u>We concluded that there was not a statistically significant difference between green bonds and their conventional counterparts, neither from the investor's standpoint nor from the issuer's</u>. While there may be intangible marketing benefits that issuers achieve through green labeling their bond offerings, our analysis found no economic benefits from going green based on new issue pricing. Overall, 74% of new issues saw no price difference compared with conventional new issues, 16% saw a price improvement, and 10% saw a price penalty. Of those issues seeing a price improvement the average was -9 basis points, and of those seeing a price penalty the average was 4bp. From the investor's standpoint, we found that 47% of green bonds saw no spread performance difference compared with the issuer's conventional bonds over the life of the issue through 31 December 2020, and that a roughly equal percentage saw relative spread tightening as saw relative spread widening. Of those issues seeing relative spread tightening the average outperformance was -3bp, and for those seeing a relative spread widening the average was 6bp. The results are summarized in Tables 4 – 4b. Green-labeled municipals are a very young asset class and it remains to be seen, that as the sector grows, whether future updates of this study reverse our findings today.

Table 4: Average performance of municipal green bond vs conventional bond from same issuer (controlling for security type, tax status, coupon, call date, and maturity)

Stats 2010-2020	Green Bond Average*	Conventional Bond Average*
# of CUSIPs	479	886
Maturity Size, $mn	$7.8	$6.5
Maturity Year	2034	2034
Issue Spread	41.4	41.1
Spread at 12/31/20	71.7	72.3
Spread Performance	22.7	21.3

Source: Bloomberg Finance LLP, FCM; April 7, 2021

* Except # of CUSIPs

Note: Spread is difference in yield measured in basis points between a reference bond and the Bloomberg AAA Baseline Muni Curve for a tax-exempt security or the Bloomberg AAA Taxable General Obligation Curve for a taxable security. Spread performance averages the change in spread for all bonds from dated date through Dec. 31, 2020.

Table 4a

Summary of Green Bond vs. Conventional Bond Pricing at Issuance (2010-2020)	Green Bond Spread at Issue vs Conventional Average
% of green bonds seeing price improvement	16%
% of green bonds seeing price penalty	10%
% of green bonds seeing no price difference	74%
Average pricing difference at issue (bp)	-1
Average green bond price improvement (bp)	-9
Average green bond price penalty (bp)	4

Source: Bloomberg Finance LLP, FCM; April 7, 2021

Note: see note to Table 4 regarding spread.

Table 4b

Summary of Green Bond vs. Conventional Bond Performance Since Issue (2010-2020)	Green Bond Spread Performance Since Issue vs Conventional Average
% of green bonds that outperformed	26%
% of green bonds that underperformed	27%
% of green bonds seeing no performance difference	47%
Average performance difference (bp)	1
Average green bond outperformance (bp)	-3
Average green bond underperformance (bp)	6

Source: Bloomberg Finance LLP, FCM; April 7, 2021

Note: see note to Table 4 regarding spread.

Important Additional Information

Key Terms:

Correlation - Measures that show the validity of a comparison to a benchmark index based on the historical relationship between portfolio returns and index returns.

Option Adjusted Duration - Bond prices typically move in the opposite direction to changes in interest rates. If interest rates rise, bond prices usually fall (and vice versa). Duration is a measure that helps approximate the degree of price sensitivity of a bond to changes in interest rates. Although stated in years, duration is often explained as an estimate of the percentage price change of a bond in response to a one percent change in interest rates. Bonds with higher duration have greater sensitivity to changes in interest rates and will generally experience a more significant drop in value as interest rates rise. For bonds with embedded options (for example callable or puttable bonds), the duration measure must be adjusted to account for the fact that the bond's embedded options may change the expected cash flows of the bond. For example, if a bond is called, interest payments cease and principal is returned earlier than the bond's maturity. The option-adjusted measure of duration is referred to as Option Adjusted Duration (OAD).

Option Adjusted Spread - A bond's yield is typically comprised of two components: 1) the yield on a similar benchmark security (typically Treasury securities) and 2) a premium above the yield on a similar benchmark security which seeks to compensate an investor for the credit risk associated with a particular bond. This premium is referred to as yield spread or simply "spread." For bonds with embedded options (for example callable or puttable bonds), the spread measure must be adjusted to account for the fact that the bond's embedded options may change the expected cash flows of the bond. For example, if a bond is called, interest payments cease and principal is returned earlier than the bond's maturity. The option-adjusted measure is referred to as Option Adjusted Spread (OAS).

Yield to Worst - the lowest potential yield that can be received on a bond without the issuer actually defaulting; calculated by making worst-case scenario assumptions on the issue by calculating the returns that would be received if any in-whole mandatory redemptive provisions are exercised by the issuer; partial redemptive provisions (such as sinking funds) are not included in yield to worst calculations; the yield to worst metric is used to evaluate the worst-case scenario for yield to help investors manage risks and ensure that specific income requirements will still be met even in the worst scenarios.

Index Definitions

Bloomberg Barclays MSCI Global Green Bond Index and **Bloomberg Barclays Global Aggregate Index**
The Bloomberg Barclays MSCI Green Bond Index offers investors an objective and robust measure of the global market for fixed income securities issued to fund projects with direct environmental benefits. An independent research driven methodology is used to evaluate index-eligible green bonds to ensure they adhere to established Green Bond Principles and to classify bonds by their environmental use of proceeds. The index was created in November 2014, with index history backfilled to January 1, 2014. Sectors included are Treasury, corporate, government-related, taxable municipal, and securitized bonds. The index is a multi-currency benchmark that includes local currency debt markets tracked by the Bloomberg Barclays Global Aggregate Index. Eligibility for index inclusion are the same for both indices unless otherwise noted below. Principal and coupon must be denominated in one of the following eligible currencies: CAD, CLP, MXN, USD, CHF, CZK, DKK, EUR, GBP, HUF, ILS, NOK, PLN, RUB, SEK, ZAR, AUD, HKD, JPY, KRW, MYR, NZD, SGD, THB. Eligible currencies will not necessarily have debt included in the index if no securities satisfy the inclusion rules. New currency inclusion is reviewed annually through the index governance process. Securities must be rated investment grade (Baa3/BBB-/BBB- or higher) using the middle rating of Moody’s, S&P and Fitch; when a rating from only two agencies is available, the lower is used; when only one agency rates a bond, that rating is used. In cases where explicit bond level ratings may not be available, other sources may be used to classify securities by credit quality. Fixed minimum issue size are set for all local currency markets, including 300mn USD (excluding MBS, ABS, and CMBS), CAD, EUR, CHF, AUD; 200mn GBP; 35bn JPY; 1bn USD MBS pass-throughs; 25mn USD ABS and CMBS tranches; 2bn DKK, NOK, PLN, ZAR, ILS, HKD, MYR; 2.5bn SEK; 10bn MXN, CZK, THB; 20bn RUB; 500mn NZD, SGD; 200bn HUF; 100bn CLP; 500bn KRW. Eligible coupons include fixed, callable fixed-to-floating are eligible during their fixed-rate term only, bonds with a step-up coupon that changes according to a predetermined schedule. Unlike other Bloomberg Barclays Aggregate Bond Indices, the Global Green Bond Index does not have a 1-year minimum time to maturity and will hold bonds until final maturity. Fixed-rate perpetual bonds are not included. Only fully taxable issues are eligible. Security types include fixed-rate bullet, putable, sinkable/amortizing and callable bonds, taxable municipal securities (Build America Bonds with the tax credit to the issuer are eligible, those with tax credits issued to investors are considered tax exempt), original issue zero coupon bonds, bonds issued through underwritten MTN programs, enhanced equipment trust certificates (EETC), certificates of deposit, fixed-rate and fixed-to-float (including fixed-to-variable) capital securities, loan participation notes, US Agency CMBS, Malaysian government Sukuk. The following securities are excluded: contingent capital securities, including traditional CoCos and contingent write-down securities with explicit capital ratio or solvency/balance sheet–based triggers, bonds with equity type features (e.g., warrants, convertibles, preferreds, DRD/QDI-eligible issues), inflation-linked bonds, floating-rate issues, fixed-rate perpetuals, tax-exempt municipal securities, private placements, sinkable Russian OFZ bonds issued prior to 2009, USD25/USD50 par bonds, structured notes, pass-through certificates, Non-ERISA eligible CMBS, US agency MBS hybrid ARMs, Formosa bonds, Illiquid securities where reliable pricing is unavailable. All index-eligible bonds are priced on a daily basis. Pricing sources are by region. US Aggregate Index: Most index-eligible bonds are priced on a daily basis by Bloomberg’s evaluated pricing service, BVAL. Certain segments of Eurodollar issues and LATAM USD-denominated bonds are priced by third-party sources. Pan-European Aggregate Index: pricing is provided by a combination of BVAL and third-party sources. Prices for CHF-denominated bonds are sourced from the Swiss stock exchange. Asian-Pacific Aggregate Index: pricing is provided by a combination of BVAL and third-party sources on a daily basis. 144A/Eurodollar Indices: pricing is provided by a combination of BVAL and third-party sources. Canadian Index: pricing is provided by Reuters. Bonds in the index are priced on the bid side. The initial price for new corporate issues entering the index is the offer side; after the first month, the bid price is used. Japanese, Euro, and Sterling treasury bonds use mid prices. T+1 calendar day settlement basis for all bonds except MBS, which are priced for Public Securities Association (PSA) settlement in the following month and discounted back to same-day settlement. At month-end, settlement is assumed to be the first calendar day of the following month, even if the last business day is not the last day of the month, to allow for one full month of accrued interest to be calculated.

Important Additional Information

S&P U.S. Municipal Green Bond Index
The index is a sub-index of the S&P Green Bond Index. The S&P Green Bond Indices are comprised of a universe of global bonds labelled “green” by Climate Bonds Initiative (CBI) and subject to eligibility criteria. A green-labelled bond is a bond whose proceeds are used to finance environmentally friendly projects. To be eligible for the S&P U.S. Municipal Green Bond Index the bond issuer must be a U.S. state (including the Commonwealth of Puerto Rico and U.S. territories) or local government or agency such that interest on the bond is exempt from U.S. federal income taxes but may be subject to alternative minimum tax (AMT). The bond must be denominated in U.S. dollars. As of the rebalancing date, the bond must have a minimum term to maturity greater than one calendar month. For any bond with an announced full call, the call date must be greater than one calendar month. The amount outstanding, or par amount, is used to determine the weight of the bond in the index. The bond must have a minimum par amount of US $ 2 million to be eligible for inclusion. The following bond types are specifically excluded: commercial paper, derivative securities (inverse floaters, forwards, & swaps), notes, taxable municipals, variable rate debt (except for known step-up/down coupon schedule bonds), defaulted bonds. The minimum credit rating for inclusion is BBB-/Baa3/BBB-. The lowest of all available ratings (S&P, Moody’s and Fitch) is used as the index rating. New issues must be rated by at least one rating agency (S&P, Moody’s or Fitch) to be considered at the next rebalancing. Bonds that are no longer rated or have defaulted are removed at the next rebalancing.

S&P Green Bond U.S. Dollar Select Index
The index is a sub-index of the S&P Green Bond Index. The S&P Green Bond Indices are comprised of a universe of global bonds labelled “green” by Climate Bonds Initiative (CBI) and subject to eligibility criteria. A green-labelled bond is a bond whose proceeds are used to finance environmentally friendly projects. To be eligible for the S&P Green Bond U.S. Dollar Select Index the bond must be denominated in U.S. dollars. Each bond must have at least 12 months to final maturity at the time of issuance to be included, and have at least one month remaining until maturity at each rebalancing date. No bond matures in the index. The minimum par outstanding must be US$ 200 million or greater. The following bond types, in addition to those excluded from the parent, are specifically excluded from the sub-index: tax-exempt municipal bonds, private placement with no registration, convertible securities, perpetual securities. The minimum credit rating for inclusion is BBB-/Baa3/BBB-. The lowest of all available ratings (S&P, Moody’s and Fitch) is used as the index rating. New issues must be rated by at least one rating agency (S&P, Moody’s or Fitch) to be considered at the next rebalancing. Non-rated bonds issued by U.S. government sponsored enterprises, such as FNMA, Freddie Mac, etc., are eligible for inclusion. Bonds that are no longer rated or have defaulted are removed at the next rebalancing.

S&P Green Bond Index
The index is a market value-weighted index designed to measure the performance of the green bond market. The S&P Green Bond Indices undergo a rebalancing process once a month. Unless otherwise noted all eligibility criteria apply to all indices. Eligibility factors specific to the sub-indices are listed above under the specific sub-index heading. Green bonds issued from any country and in any currency are eligible for index inclusion. Bonds must be flagged as “green” by CBI to be eligible for index inclusion. For a bond to be flagged green the issuer must clearly indicate the bond’s “green” label and the rationale behind it, such as the intended use of proceeds. CBI uses company disclosures to make the “green” determination. Each bond must have a maturity greater than one month from the rebalancing date. No bond matures in the index. The following coupon types are eligible for index inclusion: fixed, floaters, zero coupon, fixed-to-float, step-up. For USD and CAD denominated bonds which have multiple registrations, the 144a version will be eligible and the Reg-S will be excluded. For all other currency denominated bonds which have multiple registrations, the Reg-S will be included while the 144a will be excluded. Bonds issued up to the rebalancing reference date (regardless of the settlement date). Standard index settlement convention is same-day (e.g. T+0), unless otherwise specified. For month-ends that fall on a weekend, the interest accrued during the month will be reflected within the calendar month, regardless of settlement convention. For rates that are not available at month-end (e.g. a rate with an unknown reset), the accrual will be based on the current rate and adjusted the first business day of the next month. The following bond types are specifically excluded from the indices: bills, inflation-linked, STRIPS. Bid Price – Thomson Reuters and Securities Evaluations | ICE Data Services are the designated pricing sources. Bonds not priced by Thomson Reuters or Securities Evaluations | ICE Data Services are not eligible for index inclusion.

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Diversification does not ensure a profit or guarantee against a loss. Interest income earned from tax-exempt municipal securities generally is exempt from federal income tax, and may also be exempt from state and local income taxes if you are a resident in the state of issuance. A portion of the income you receive may be subject to federal and state income taxes, including the federal alternative minimum tax. In addition, you may be subject to tax on amounts recognized in connection with the sale of municipal bonds, including capital gains and “market discount” taxed at ordinary income rates. “Market discount” arises when a bond is purchased on the secondary market for a price that is less than its stated redemption price by more than a statutory amount. Before making any investment, you should review the official statement for the relevant offering for additional tax and other considerations.

The municipal market can be adversely affected by tax, legislative, or political changes and the financial condition of the issuers of municipal securities. Investing in municipal bonds for the purpose of generating tax-exempt income may not be appropriate for investors in all tax brackets or for all account types. Tax laws are subject to change and the preferential tax treatment of municipal bond interest income may be revoked or phased out for investors at certain income levels. You should consult your tax adviser regarding your specific situation.

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