The Cost of Being Green

- 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)

![Bar Chart]

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

FIGURE 2
Distribution of Green Bond Universe by Issuer Region

![Pie Chart]

**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 of constituents with the Global Green Bond Index.

**FIGURE 3**

| 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°           | 1°              | 0.3°            | 0.1°            | 1.3°            | 1.7°            | 1.7°            | 1.7°            | 1.7°            | 1.7°            | 1.8°            |
| Standard Error      | 7.7             | 0.0             | 0.1             | 1.3             | 1.7             | 1.7             | 1.7             | 1.7             | 1.7             | 1.7             | 1.7             | 1.7             | 1.7             | 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            | 1°              | 0.3°            | 0.1°            | 1.3°            | 1.7°            | 1.7°            | 1.7°            | 1.7°            | 1.7°            |
| Adjusted R²         | 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 reports3 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 city4. 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.

---

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
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.
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...
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 municiplals 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\(^1\). 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.

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

Source: ICMA, Barclays Research

\(^1\) “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

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.
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.
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.
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 $t$.

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

- **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.
Eligible Projects and Tracking Methodologies Vary Among Green Bond Issuers

<table>
<thead>
<tr>
<th>Use of Proceeds</th>
<th>European Investment Bank</th>
<th>Bank of America</th>
<th>Vornado Realty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eligible Projects</strong></td>
<td>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.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>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.</td>
<td>-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.</td>
<td></td>
</tr>
</tbody>
</table>

| 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.
Important Disclosures:
Barclays Research is a part of the Investment Bank of Barclays Bank PLC and its affiliates (collectively and each individually, "Barclays"). For current important disclosures regarding companies that are the subject of this research report, please send a written request to: Barclays Research Compliance, 745 Seventh Avenue, 14th Floor, New York, NY 10019 or refer to http://publicresearch.barclays.com or call 212-526-1072.

Barclays Capital Inc. and/or one of its affiliates does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that Barclays may have a conflict of interest that could affect the objectivity of this report. Barclays Capital Inc. and/or one of its affiliates regularly trades, generally deals as principal and generally provides liquidity (as market maker or otherwise) in the debt securities that are the subject of this research report (and related derivatives thereof). Barclays trading desks may have either a long and/or short position in such securities, other financial instruments and/or derivatives, which may pose a conflict with the interests of investing customers. Where permitted and subject to appropriate information barrier restrictions, Barclays fixed income research analysts regularly interact with its trading desk personnel regarding current market conditions and prices. Barclays fixed income research analysts receive compensation based on various factors including, but not limited to, the quality of their work, the overall performance of the firm (including the profitability of the Investment Banking Department), the profitability and revenues of the Markets business and the potential interest of the firm's investing clients in research with respect to the asset class covered by the analyst. To the extent that any historical pricing information was obtained from Barclays trading desks, the firm makes no representation that it is accurate or complete. All levels, prices and spreads are historical and do not represent current market levels, prices or spreads, some or all of which may have changed since the publication of this document. The Investment Bank's Research Department produces various types of research including, but not limited to, fundamental analysis, equity-linked analysis, quantitative analysis, and trade ideas. Recommendations contained in one type of research may differ from recommendations contained in other types of research, whether as a result of differing time horizons, methodologies, or otherwise. Unless otherwise indicated, trade ideas contained herein are provided as of the date of this report and are subject to change without notice due to changes in prices. In order to access Barclays Statement regarding Research Dissemination Policies and Procedures, please refer to https://live.barcap.com/publiccp/RSR/nyfipubs/disclaimer/disclaimer-research-dissemination.html. In order to access Barclays Research Conflict Management Policy Statement, please refer to: https://live.barcap.com/publiccp/RSR/nyfipubs/disclaimer/disclaimer-conflict-management.html.

The MSCI sourced information is the exclusive property of MSCI Inc. (MSCI). Without prior written permission of MSCI, this information and any other MSCI intellectual property may not be reproduced, redisseminated or used to create any financial products, including any indices. This information is provided on an "as is" basis. The user assumes the entire risk of any use made of this information. MSCI, its affiliates and any third party involved in, or related to, computing or compiling the information hereby expressly disclaim all warranties of originality, accuracy, completeness, merchantability or fitness for a particular purpose with respect to any of this information. Without limiting any of the foregoing, in no event shall MSCI, any of its affiliates or any third party involved in, or related to, computing or compiling the information have any liability for any damages of any kind. MSCI and the MSCI indexes are services marks of MSCI and its affiliates.

Barclays legal entities involved in publishing research:
Barclays Bank PLC (Barclays, UK)
Barclays Capital Inc. (BCI, US)
Barclays Securities Japan Limited (BSL, Japan)
Barclays Bank PLC, Tokyo branch (Barclays Bank, Japan)
Barclays Bank PLC, Hong Kong branch (Barclays Bank, Hong Kong)
Barclays Capital Canada Inc. (BCCI, Canada)
Absa Bank Limited (Absa, South Africa)
Barclays Bank Mexico, S.A. (BBMX, Mexico)
Barclays Capital Securities Taiwan Limited (BCSTW, Taiwan)
Barclays Capital Securities Limited (BCSL, South Korea)
Barclays Securities (India) Private Limited (BSIPL, India)
Barclays Bank PLC, India branch (Barclays Bank, India)
Barclays Bank PLC, Singapore branch (Barclays Bank, Singapore)
Barclays Bank PLC, Australia branch (Barclays Bank, Australia)

Disclaimer
This publication has been produced by the Investment Bank of Barclays Bank PLC and/or one or more of its affiliates (collectively and each individually, "Barclays"). It has been distributed by one or more Barclays legal entities that are a part of the Investment Bank as provided below. It is provided to our clients for information purposes only, and Barclays makes no express or implied warranties, and expressly disclaims all warranties of merchantability or fitness for a particular purpose with respect to any data included in this publication. Barclays will not treat unauthorized recipients of this report as its clients. Prices shown are indicative and Barclays is not offering to buy or sell or soliciting offers to buy or sell any financial instrument. Without limiting any of the foregoing and to the extent permitted by law, in no event shall Barclays, nor any affiliate, nor any of their respective officers, directors, partners, or employees have any liability for (a) any special, punitive, indirect, or consequential damages; or (b) any lost profits, lost revenue, loss of anticipated savings or loss of opportunity or other financial loss, even if notified of the possibility of such damages, arising from any use of this publication or its contents.

Other than disclosures relating to Barclays, the information contained in this publication has been obtained from sources that Barclays Research believes to be reliable, but Barclays does not represent or warrant that it is accurate or complete. Barclays is not responsible for, and makes no warranties whatsoever as to, the content of any third-party web site accessed via a hyperlink in this publication and such information is not incorporated by reference. The views in this publication are those of the author(s) and are subject to change, and Barclays has no obligation to update its opinions or the information in this publication. The analyst recommendations in this publication reflect solely and exclusively those of the author(s), and such opinions were prepared independently of any other interests, including those of Barclays and/or its affiliates. This publication does not constitute personal investment advice or take into account the individual financial circumstances or objectives of the clients who receive it. The securities discussed herein may not be suitable for all investors. Barclays recommends that investors independently evaluate each issuer, security or instrument discussed herein and consult any independent advisors they believe necessary. The value of and income from any investment may fluctuate from day to day as a result of changes in relevant economic conditions.
markets (including changes in market liquidity). The information herein is not intended to predict actual results, which may differ substantially from those reflected. Past performance is not necessarily indicative of future results.

This material has been issued and approved for distribution in the UK and European Economic Area by Barclays Bank PLC. It is being made available primarily to persons who are investment professionals as that term is defined in Article 19 of the Financial Services and Markets Act 2000 (Financial Promotion) Order 2005. It is directed at, and should only be relied upon by, persons who have professional experience in matters relating to investments. The investments to which it relates are available only to such persons and will be entered into only with such persons. Barclays Bank PLC is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority and is a member of the London Stock Exchange.

The Investment Bank of Barclays Bank PLC undertakes U.S. securities business in the name of its wholly owned subsidiary Barclays Capital Inc., a FINRA and SIPC member. Barclays Capital Inc., a U.S. registered broker/dealer, is distributing this material in the United States and, in connection therewith accepts responsibility for its contents. Any U.S. person wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of Barclays Capital Inc. in the U.S. at 745 Seventh Avenue, New York, New York 10019.

Non-U.S. persons should contact and execute transactions through a Barclays Bank PLC branch or affiliate in their home jurisdiction unless local regulations permit otherwise.

Barclays Bank PLC, Paris Branch (registered in France under Paris RCS number 381 066 281) is regulated by the Autorité des marchés financiers and the Autorité de contrôle prudentiel. Registered office 34/36 Avenue de Friedland 75008 Paris.

This material is distributed in Canada by Barclays Capital Canada Inc., a registered investment dealer, a Dealer Member of IIROC (www.iiroc.ca), and a Member of the Canadian Investor Protection Fund (CIPF).

Subject to the conditions of this publication as set out above, the Corporate & Investment Banking Division of Aba Bank Limited, an authorised financial services provider (Registration No.: 1986/004794/06. Registered Credit Provider Reg No NCRCP7), is distributing this material in South Africa. Aba Bank Limited is regulated by the South African Reserve Bank. This publication is not, nor is it intended to be, advice as defined and/or contemplated in the (South African) Financial Advisory and Intermediary Services Act, 37 of 2002, or any other financial, investment, trading, tax, legal, accounting, retirement, actuarial or other professional advice or service whatsoever. Any South African person or entity wishing to effect a transaction in any security discussed herein should do so only by contacting a representative of the Corporate & Investment Banking Division of Aba Bank Limited in South Africa, 15 Alice Lane, Sandton, Johannesburg. Cauteng 2196, Aba Bank Limited is a member of the Baruchs group.

In Japan, foreign exchange research reports are prepared and distributed by Barclays Bank PLC Tokyo Branch. Other research reports are distributed to institutional investors in Japan by Barclays Securities Japan Limited. Barclays Securities Japan Limited is a joint-stock company incorporated in Japan with registered office of 6-10-1 Roppongi, Minato-ku, Tokyo 106-6131, Japan. It is a subsidiary of Barclays Bank PLC and a registered financial instruments firm regulated by the Financial Services Agency of Japan. Registered Number: Kanto Zaimukyokuchou (kinsho) No. 143.

Barclays Bank PLC, Hong Kong Branch is distributing this material in Hong Kong as an authorised institution regulated by the Hong Kong Monetary Authority. Registered Office: 41/F, Cheung Kong Center, 2 Queen's Road Central, Hong Kong.

Information on securities/instruments that trade in Taiwan or written by a Taiwan-based research analyst is distributed by Barclays Capital Securities Taiwan Limited to its clients. The material on securities/instruments not traded in Taiwan is not to be construed as ‘recommendation’ in Taiwan. Barclays Capital Securities Taiwan Limited does not accept orders from clients to trade in such securities. This material may not be distributed to the public media or used by the public media without prior written consent of Barclays.

This material is distributed in South Korea by Barclays Capital Securities Limited, Seoul Branch, All Indian securities-related research and other equity research produced by the Investment Bank are distributed in India by Barclays Securities (India) Private Limited (BSIPL). BSIPL is a company incorporated under the Companies Act, 1956 having CIN U67120MH2006PTC161063. BSIPL is registered and regulated by the Securities and Exchange Board of India (SEBI) as a Portfolio Manager INP000000258; Stock Broker/Trading and Clearing Member: National Stock Exchange of India Limited (NSE) Capital Market INB231292732, NSE Futures & Options INF231292732, NSE Currency derivatives INE231450334, Bombay Stock Exchange Limited (BSE) Capital Market INB011292738, BSE Futures & Options INF011292738; Merchant Banker: INM00011195; Depository Participant (DP) with the National Securities & Depositories Limited (NSDL): DP ID: IN-DP-NSDL-299-2008; Investment Adviser: INA000000391. The registered office of BSIPL is at 208, Ceejay House, Shivsgar Estate, Dr. A. Besant Road, Worli, Mumbai – 400 018, India. Telephone No: +91 22 67196000. Fax number: +91 22 67196100. Any other reports produced by BSIPL in India that is registered with Reserve Bank of India (RBI) as a Banking Company under the provisions of The Banking Regulation Act, 1949 (Regn No BOM43) and registered with SEBI as Merchant Banker (Regn No INM000002129) and also as Banker to the Issue (Regn No INB000000950). Barclays Investments and Loans (India) Limited, registered with RBI as Non Banking Financial Company (Regn No RBI Co-07-000258), and Barclays Wealth Trustees (India) Private Limited, registered with Registrar of Companies (CIN U89300MH2008PTC188438), are associates of BSIPL in India that are not authorised to distribute any reports produced by the Investment Bank.

Barclays Bank PLC Frankfurt Branch distributes this material in Germany under the supervision of Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin).

This material is distributed in Malaysia by Barclays Bank Markets Malaysia Sdn Bhd.

This material is distributed in Brazil by Banco Barclays S.A.

This material is distributed in Mexico by Barclays Bank Mexico, S.A.

Barclays Bank PLC in the Dubai International Financial Centre (Registered No. 0060) is regulated by the Dubai Financial Services Authority (DFSA). Principal place of business in the Dubai International Financial Centre: The Gate Village, Building 4, Level 4, PO Box 506504, Dubai, United Arab Emirates. Barclays Bank PLC-DIFC Branch, may only undertake the financial services activities that fall within the scope of its existing DFSA licence. Related financial products or services are only available to Professional Clients, as defined by the Dubai Financial Services Authority.

Barclays Bank PLC in the UAE is regulated by the Central Bank of the UAE and is licensed to conduct business activities as a branch of a commercial bank incorporated outside the UAE in Dubai (Licence No.: 13/1844/2008, Registered Office: Building No. 6, Bui Dubai Business Hub, Sheikh Zayed Road, Dubai City) and Abu Dhabi (Licence No.: 13/952/2008, Registered Office: Al Jazira Towers, Hamdan Street, PO Box 2734, Abu Dhabi).

Barclays Bank PLC in the Qatar Financial Centre (Registered No. 00018) is authorised by the Qatar Financial Centre Regulatory Authority (QFCRA). Barclays Bank PLC-QFC Branch may only undertake the regulated activities that fall within the scope of its existing QFCRA licence. Principal place of business in Qatar: Qatar Central Bank, Office 1002, 10th Floor, QFC Tower, Diplomatic Area, West Bay, PO Box 15891, Doha, Qatar. Related financial products or services are only available to Business Customers as defined by the Qatar Financial Centre Regulatory Authority.

This material is distributed in the UAE (including the Dubai International Financial Centre) and Qatar by Barclays Bank PLC.

This material is distributed in Russia by OOO Barclays Capital, affiliated company of Barclays Bank PLC, registered and regulated in Russia by the FSFM. Broker License #177-11850-10000; Dealer License #177-11855-01000. Registered address in Russia: 125047 Moscow, 1st Tverskaya-Yamskaya str. 21.

This material is distributed in Singapore by the Singapore branch of Barclays Bank PLC, a bank licensed in Singapore by the Monetary Authority of Singapore. For matters in connection with this report, recipients in Singapore may contact the Singapore branch of Barclays Bank PLC, whose registered address is 10