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WHITE PAPER

The greenium in high-rated euro bonds

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"Over the past years the green bond market has grown from a small niche market to a liquid and diversified market

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Marketing material for professional investors, not for onward distribution


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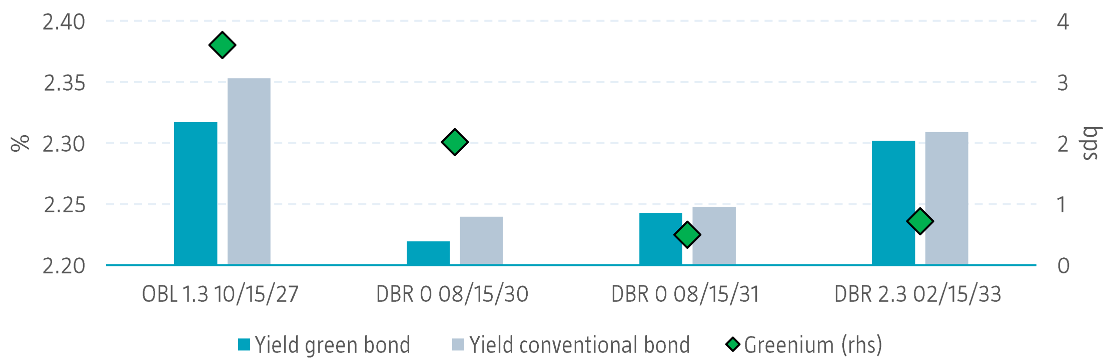
What is the greenium?

Institutional investors who want to shape their investment portfolio to meet their ESG goals are increasingly turning to green bonds. Green bonds are intended to exclusively finance projects that have a positive environmental impact. As a result, these bonds use their proceeds differently, and have unique certification and reporting standards. They also have a distinct investor approach, which can lead to differences in pricing. Roughly half of EUR-denominated green debt is issued by Eurozone governments and government-related institutions such as supranationals, sovereigns and agencies (SSA). In this article, we examine the premium of green bonds for these two groups.

The greenium is the difference in yield between a green bond and a comparable conventional bond[1]. From the perspective of an issuer, the greenium can be seen as compensation for ring-fencing the use of proceeds and more stringent requirements, such as additional reporting and third-party certification required to issue green bonds. A positive greenium reflects the situation where a green bond is priced with a yield *below* the conventional bond and therefore lowers borrowing costs for an issuer. From an investor point of view, the greenium can be seen as the premium investors are willing to pay for holding the green bond over a conventional bond. This is often linked to sustainable investment policies which require investors to hold a certain portion of their portfolio in ESG-labeled bonds. As many investors are looking to expand their green bond holdings, these bonds also face less (or delayed) selling pressure in market downturns, a visible factor during the spread widening in September 2023.

Often the greenium is small, or non-existent when bonds are issued in the primary market. This is because new issues are normally brought to the market with a small discount to entice investors to absorb the extra supply. When traded in the secondary market, green bonds tend to become more expensive on a relative basis, but prices vary over time, and in some cases green bonds have even been priced with a small negative greenium. Sometimes the greenium is easy to identify, especially in cases where a 'twin' conventional bond is issued. The most important examples of these are the German twin government bonds. Figure 1 plots the yield differences for a selection of these twin bonds to illustrate the greenium. All four pairs have a conventional bond with a slightly higher yield compared to that of the green bond, indicating the positive greenium investors are willing to pay.

Figure 1 - Greenium of selected German twin bonds.



Source: Robeco, Bloomberg. Data as of 1st of February 2024

1 This article focuses mainly on green bonds, which constitutes the largest part of ESG labeled bonds. A similar premium can be calculated for social and sustainable ESG-labeled bonds. For a complete overview of the green bond market, see Swinkels (2022) 'Allocating to green bonds.'

However, no such comparable twin bonds are available for the large majority of green bonds. Therefore, to assess the greenium of the broader market segment, some estimation technique is required. In this article, we estimate the greenium for EUR-denominated government and government-related (or SSA) issuers and we analyze its dynamics over the past year. Moreover, we look at how this greenium compares over time for these two market segments and we argue that the differences are likely driven by liquidity and supply-related factors. One takeaway is evident from our results: The greenium is not static and green bond investors can benefit from being both active in the primary market and selective about which green issuers they choose to invest in via the secondary market.

Estimation of the greenium

In literature and market research, there are two common approaches to estimating the greenium. The first method is based on a matching algorithm that aims to select the most appropriate conventional bond for a specific green bond and then calculates the spread[2]. The second method aims to estimate the conventional curve first, and then calculates the greenium as the spread between the green bond and the estimated curve at that given maturity. For the purpose of this research we opt for the latter, as it accounts for differences in maturity and should produce more accurate and less volatile estimates for the relatively modest sample size. Moreover, the relatively liquid issues and well-defined curves that are characteristic of government and government-related issuers allows for accurate estimation of the conventional curve.

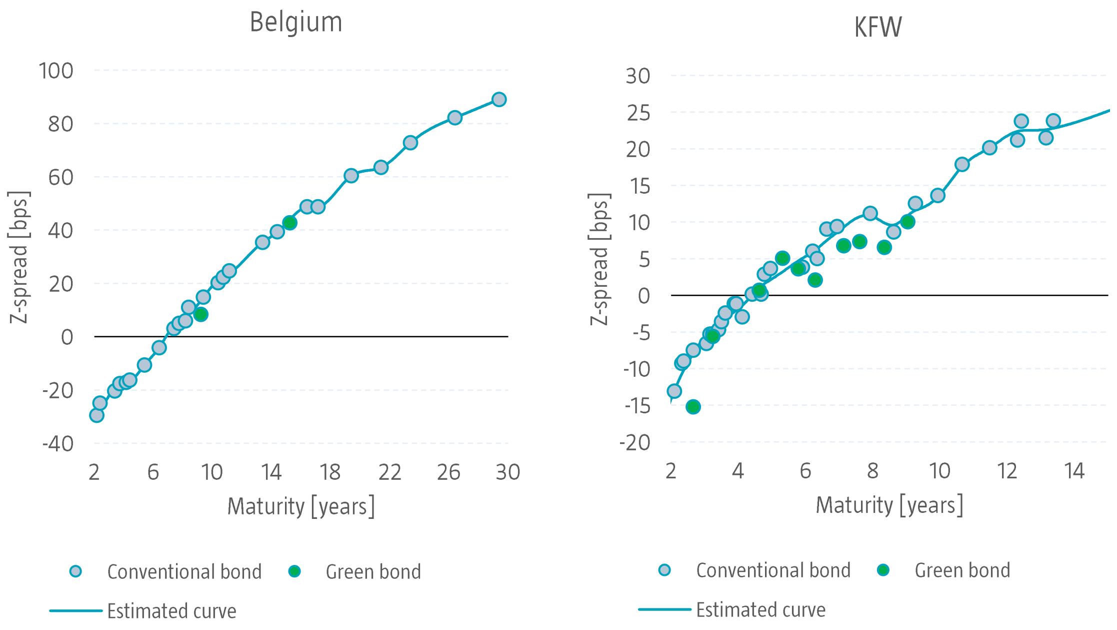
The starting point for the analysis is the full universe of investment-grade green Euro government and government-related bonds. Bonds of those issuers for which we cannot construct a conventional curve are filtered out[3]. Green bonds on the very short and long end of the curve are excluded, as these curve segments are prone to idiosyncrasies and are more difficult to estimate accurately. Lastly, to limit the impact of liquidity on the estimation, smaller issues with an amount outstanding of less than EUR 750 mln are also removed from the sample.

> *“Green bond investors can benefit from being both active in the primary market and selective about which green issuers they choose to invest in via the secondary market*

Table 1 on the following page presents an overview of the resulting collection of green bonds. In total, there are about 60 green bonds in the sample, consisting of 17 government and 43 government-related bonds. It is important to note that there are two government-related issuers – KFW and EIB – that both have a large number of green bonds outstanding and account for about a third of the total sample. A majority of the issuers in the sample have between two and four green bonds outstanding. For each green issuer a conventional curve has been constructed. For this the Z-spread of the bonds was used, rather than the yield to maturity[4]. This gives the most realistic comparison between bonds with different cash-flow characteristics. The selected method to construct the curve has the advantage of aligning the curve more closely with the behavior of individual bonds[5]. Two examples of this process are shown in Figure 2. The left panel shows the Belgium government curve with the two green bonds indicated in green. Similarly, the right panel shows the conventional curve for the government-related issuer KFW.

2 For reference, see the ECB working paper: Pietsch (2022) ‘Pricing of green bonds: drivers and dynamics of the greenium.’
3 Some issuers only issue green bonds such that it is not possible to construct the conventional curve. Alternatively some issuers have too few bonds outstanding.
4 Z-spread, in contrast with other spread or yield measures takes into account the rate at each coupon date and is therefore a more accurate means of comparison for long-dated or high coupon bonds in an environment with a steep yield curve. For ‘regular’ bonds the Z-spread will be very similar to the spread over swap.
5 A non-parametric kernel-smoothed cubic spline interpolation is used in contrast with the more common NSS parametric estimation.

Figure 2 – Curve estimation for Belgium (left) and a government-related issuer, KFW (right). Green bonds are highlighted.



Source: Robeco, Bloomberg. Data as of 1st of February 2024.

In Figure 2 the majority of green bonds are trading more expensive than the conventional curve, which is graphically depicted by the green dots falling (slightly) below the blue line. Similar to a lower yield, a lower z-spread translates into a higher price and thus a premium over conventional bonds. The greenium is calculated as the difference between the Z-spread of the green bond and that of the estimated conventional curve at the maturity of the green bond. For each issuer we take the median of the calculated premia of the green bonds in an effort to limit the influence of outliers.

Two examples of such outliers can be seen on the right panel with both the KFW 0 ½ 09/28/26 which has a very large premium and the KFW 0 06/15/29 which has a *negative* premium. A negative estimated premium can result from either *temporary* mispricing, or uncertainty in the estimation process. Using the simple example of Belgium, a premium can be calculated of 5.2 bps for the BGB 1 ¼ 04/22/33 and 1.2 bps for the BGB 2 ¾ 04/22/39, resulting in a median greenium of 3.2 bps.

Results: how large is the greenium?

Table 1 shows an overview of the estimated greenium for each issuer in the sample. For the complete sample a median greenium of 2.2 bps is estimated. In other words, current market pricing suggests that investors are willing to forgo roughly 2 bps on yield by having green-labeled bonds over their conventional counterparts. Obviously, this remains an aggregate measure and there is quite some variation in estimated greenium among issuers, as can be seen in the right column of Table 1. Nevertheless, most issuers are estimated to have a greenium in the range of between 1 and 4 bps. This is in line with expectations based on the example of German twin bonds, as well as what we observe on a daily basis in the market. A few key characteristics of the green bond market help to explain the drivers behind variations in the greenium. First: demand for labelled bonds and specifically demand for green bonds is growing fast as more investors see green bonds as a key instrument to increase the sustainability characteristics of their investment portfolio. Secondly, this large investor demand meets a more mature market, however, this market is in a buildup phase and issuers are in the process of establishing a green curve, meaning there will be a scarcity of bonds from specific issuers in particular maturities.

Our research suggests that issuers with a large number of green bonds outstanding tend to have a relatively stable and modest greenium compared to others. For EIB, EU and KFW we find a greenium of 1.2, 1.3 and 1.8 bps, respectively. As the supply of short-term green paper is scarce, we would have expected to see a larger greenium for bonds with a maturity between two and five years. Additionally, from a diversified portfolio construction perspective, these tenors would be more favorable[6]. Although we observe this for several individual liquid issuers such as EIB and the German government, it is not consistently observed for the sample as a whole.

Table 1 - Estimated greenium for selected sample of EUR sovereign and government-related green bonds.

Issuer	Ticker	Issuer type	Number of Green Bonds	Median Greenium
Germany	OBL/DBR	Government	4	2.2
France	FRTR	Government	2	1.9
Italy	BTPS	Government	3	2.2
Spain	SPGB	Government	1	0.5
Netherlands	NETHER	Government	2	1.4
Belgium	BGB	Government	2	3.2
Ireland	IRISH	Government	2	3.0
Austria	RAGB	Government	1	5.3
European Union	EU	Government-related	4	1.3
European Investment Bank	EIB	Government-related	13	1.2
Kreditanstalt für Wiederaufbau	KFW	Government-related	10	1.8
Nederlandsche Waterschapsbank	NEDWBK	Government-related	1	4.2
Landwirtschaftliche Rentenbank	RENTEN	Government-related	4	1.2
North Rhine-Westphalia Bank	NRWBK	Government-related	2	5.2
SNCF Reseau	RESFER	Government-related	5	3.9
State of Hessen	HESSEN	Government-related	1	1.2
Bpifrance SACA	BPIFRA	Government-related	2	3.5
Kommunekredit	KOMMUN	Government-related	1	2.4
Total Sample			60	2.2

Source: Robeco, Bloomberg. Data as of 1st of February 2024. Government and government-related universe. Some bonds have been deselected based on either issue size or maturity length (see method).

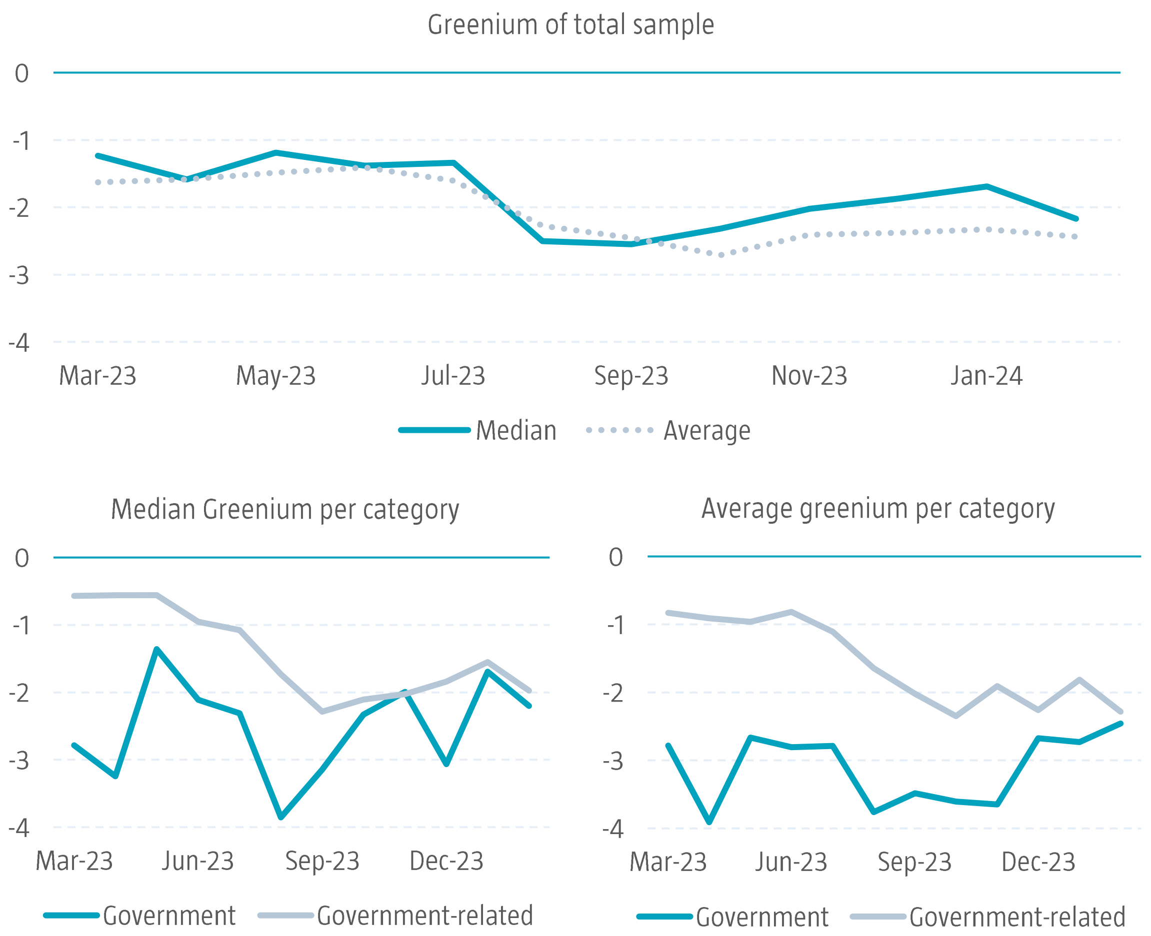
What drives the greenium over time?

The results so far have been based on a market snapshot of bond prices at a single point in time. In order to both check the volatility of the aggregate greenium estimate and to analyze the dynamics of the greenium, the estimation was repeated at monthly intervals over the past year. Figure 3 shows the resulting time series. The left panel indicates that for the sample as a whole the greenium estimate is quite stable. Last year the estimated greenium ranged between 1 bps and 3 bps, with a notably lower greenium before August 2023. The bottom left panel shows the median greenium for two sub samples, split between government and government-related issuers. This suggests that the decrease in greenium in H1 of 2023 is driven by the government-related subsample. The subsample for government bonds displays some volatility because of the small sample size but

6 With lower maturity bonds you have a higher market value percentage of green bonds for the same interest rate exposure (duration risk).

seems reasonably confined to its mean of around 2.5 bps[7]. If we look at the *average* greenium per category on the bottom right panel of Figure 3, we can confirm that over the previous year the greenium for government issuers remained more or less the same. This supports the earlier observation that the increase in greenium over last year was solely driven by the government-related subsample. Since the length of our time series is limited to one year only, it is difficult to draw conclusions from this divergence between the two subsamples. Yet from a market perspective, we can identify two factors that were likely to have contributed to a less stable greenium for government-related bonds, compared to government bonds in general. These are discussed in greater depth in this section.

Figure 3 - Estimated greenium over time for combined (top) and split (bottom) sample of EUR government and government-related issuers.



Source: Robeco, Bloomberg. Data as of 1st of February 2024.

The first, and arguably the most direct, factor concerns the effect of supply of new green bonds in this segment. In a situation where net green bond supply steadily outpaces the rise in demand, investors can fairly easily meet their green bond allocation targets by simply being active in the primary market. For more on this topic, please see Bänziger, Van Brecht, and Swinkels (2024) 'How many sustainable bonds in the matching portfolio?' This means that the premium investors are willing to pay in the secondary market decreases as net supply increases. The opposite also holds for a decrease in net supply. The EU as an issuer is a good example. In the second half of 2023 the EU issued only 12% in green bonds, or about half of what was expected. As the EU is the largest issuer in the government-related segment, this resulted in a meaningful undershoot of about EUR 7 bln in green bond supply relative to expectations. Figure 4 supports this argument for the specific case of last year, which indeed saw the

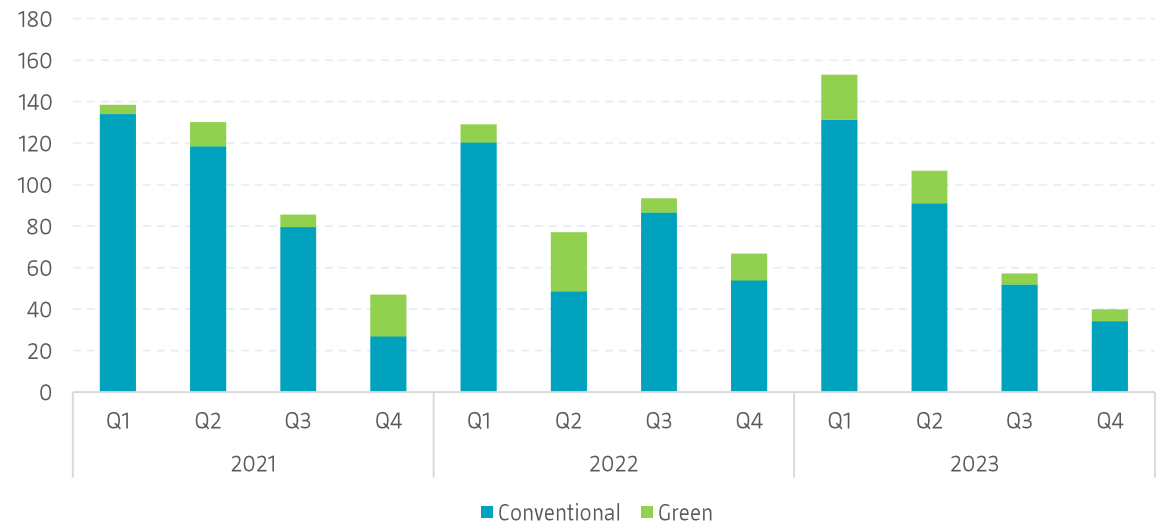
7 Over last year the total sample number slightly increased from 51 to 60, as more new green bonds were issued. However, this did not drive the observed difference in the June-September period.

majority of the green bond supply taking place in the first few months. This corresponded with a lower observed greenium in this period. In general, the volatile supply of green bonds for this market segment can result in a more time-varying greenium, relative to that of green bonds from governments.

The second factor relates to the *relatively* lower liquidity of the government-related issuers compared to that of the government bonds on the secondary market. With the exclusion of the EU, EIB and KFW, government-related issuers have relatively modest funding needs compared to that of governments. This translates to fewer and smaller bond lines and thus reduced trading across the curve. As the SSA market is an over-the-counter market, the data used in this analysis is based on *quotes* (screen) prices, not traded prices. During pockets of low liquidity this can mean that for some issuers, the screen prices of the often smaller, green lines, are not necessarily tradeable prices[8]. This was visible in September 2023, when there was a substantial sell-off in government-related bonds and the smaller issuers seemed to be less affected. This may be explained by a longer-term desire to expand green bond allocations, suggesting there were less transactions in this market segment.

Yet, for smaller issuers this outperformance was artificially inflated by reduced liquidity. Following this line of argument, the *observed* greenium of smaller issuers can trail that of large issuers like: KFW, EIB and EU. This line of reasoning could explain why the greenium for these small issuers is in general more susceptible to change over time. Much of this liquidity is linked to primary issuance volumes. As supply in government-related bonds tends to be heavily front-loaded in the first half of the year, these smaller issuers experience substantially more spread volatility over these periods. Figure 4 supports this argument by showing the issuance of this segment during the past three years. Last year, 73% of the total volume was issued in the first six months, meaning in the second half of the year there was less liquidity. The reduced liquidity in this latter period is consistent with the aggregate greenium measures higher compared to that of EIB, KFW and EU.

Figure 4 - Quarterly issuance in EUR bln for government-related issuers over the last three years.



Source: Robeco, Bloomberg, Credit Agricole. Data as of 1st of February 2024.

8 An example of this are the green bonds of Rentenbank that were quoted with a negative greenium in Q3 2023, yet real executable prices were much higher.

Conclusion

This research assesses the premium of green bonds in the EUR-denominated government and government-related bond market. The large majority of these green bonds do not have comparable conventional bonds, meaning that estimation is required to calculate the aggregate greenium. Our analysis shows that investors are currently willing to pay a premium of roughly 2 bps in this market segment. Although relatively modest in size, this does indicate a consistent investor preference for green bonds over their conventional counterparts. The greenium can vary among issuers, but the majority falls in the range between 1 and 4 bps and over time, the greenium of green government-related bonds shows more variation relative to government bonds. We link this to a more volatile supply of green bonds in the primary market, as well as a more time varying liquidity in this segment. This offers opportunities for an active investment approach in this market. It also suggests that using primary market activity should allow investors to build an ESG-labeled bond allocation without being forced to pay a sizeable greenium. In our opinion this underlines the attractiveness of green bonds as an asset class in shaping investment portfolios to meet ESG goals.

Over the past years the green bond market has grown from a small niche market to a liquid and diversified market. Our analysis of the greenium suggests that the secondary market is functioning well, with green bonds priced close to their non-green peers. The increase in issuance volumes, as witnessed over the past years, has made it possible to build sizeable portfolios in this market. With many new green initiatives on the agenda and a growing environmental awareness within society, we expect continued strong growth for the green bond market in the years to come.

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Robeco Institutional Asset Management B.V., Sucursal en España with identification number W0032687F and having its registered office in Madrid at Calle Serrano 47-14º, is registered with the Spanish Commercial Registry in Madrid, in volume 19.957, page 190, section 8, sheet M-351927 and with the National Securities Market Commission (CNMV) in the Official Register of branches of European investment services companies, under number 24. The investment funds or SICAV mentioned in this document are regulated by the corresponding authorities of their country of origin and are registered in the Special Registry of the CNMV of Foreign Collective Investment Institutions marketed in Spain.
Additional information for investors with residence or seat in South Africa
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Robeco is deemed authorized and regulated by the Financial Conduct Authority.
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The sale of the Fund qualifies as a private placement pursuant to section 2 of Uruguayan law 18,627. The Fund must not be offered or sold to the public in Uruguay, except under circumstances which do not constitute a public offering or distribution under Uruguayan laws and regulations. The Fund is not and will not be registered with the Financial Services Superintendency of the Central Bank of Uruguay. The Fund corresponds to investment funds that are not investment funds regulated by Uruguayan law 16,774 dated 27 September 1996, as amended.