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ANTHROPOCENE FIXED INCOME INSTITUTE

# SUSTAINABILITY-LINKED BOND HANDBOOK

## A practitioner's guide

anthropocene FIXED INCOME INSTITUTE

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## A practitioner's guide

**Ulf Erlandsson and Josephine Richardson**
with Stephanie Mielnik, Kamesh Korangi and Cedric Rimaud

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In 2020, Ulf founded the Anthropocene Fixed Income Institute to devise and advocate for practical strategies to drive climate positive capital flows in the fixed income markets. The institute has quickly become a thought leader in the credit space on climate and nature loss. Ulf was awarded Bond Personality of the Year 2022 by Environmental Finance in recognition of the institute's impact.

Ulf received his Ph.D. in Economics from Lund University with his thesis focused on transition probabilities in regime switching models.

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# FOREWORD

**Sustainability-Linked Bonds (SLBs) have a crucial part to play in unlocking the power of the largest pool of global capital – fixed income – to invest in and propel the climate transition.**

This book shows how SLBs can incentivise bond issuers to meet ambitious climate targets and achieve a lower cost-of-capital if they are structured correctly. At the same time, investors who believe that transitioning companies yield better returns or are lower risk, can position for this credibly through SLBs. SLBs carry the promise of bringing together investors and issuers on the urgent and necessary climate transition financing journey.

Of course, there remains some scepticism about the instrument. We, at the Anthropocene Fixed Income Institute, shared this when we first started analysing SLBs in 2020. However, using a quantitative approach, we soon discovered that the compelling characteristics of the structure significantly supersede many of the weaknesses identified.

Our team of experienced, former portfolio managers and traders aims to deliver the kind of objective research and analysis that would have been valuable to us when first embarking on our own sustainability journeys. That is why this is a 'handbook', a technical guide that will help market participants to deploy SLBs that achieve attractive financial outcomes while delivering measurable impact.

A central theme of the book and a key concept to understand is how pricing can be used to structure ambitious SLBs that will attract investors and, ultimately, scale the SLB market. The option pricing model developed in Chapter 2 (required reading), which is further advanced in Chapter 5, brings us back to market fundamentals and forms the basis of responding to questions such as 'is the SLB ambitious?', 'how should it price?', 'will it have impact?', or 'what should the coupon-step up be?' These key chapters include many case studies, providing the reader with practical examples on the logic of option pricing. To achieve the instrument's full potential, it is essential to price SLBs effectively. This is a critical element missing from many of today's discussions.

Chapter 3 is dedicated to the role of SLBs in investor portfolios, from pure alpha generation to impact investing, and how they should drive both high-level sustainability commitments and stronger data diligence. This is an area of rapid change; we will surely look back on some of the writing in a few years' time having seen substantial developments. However, the key point of this chapter is that SLBs should play an active, elevated role in transition-focused investors' portfolios.

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# FOREWORD

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Throughout this book we will discuss the many features appearing in SLBs, and evaluate which make sense, and which less so, both from an impact and financial perspective. Chapter 4 specifically discusses the topic of target setting, as well as the technical details around dates and coupon payments. The immense versatility and flexibility of the SLB structure (you can literally include a coupon change of any sort on any conditionality) has opened it up for some of the above-mentioned criticism but, in this book, we will point to the clear advantages of the structure including how it can be applied in different areas such as nature loss, just transition, and blended finance (Chapter 6).

**The SLB Handbook represents the quantum of knowledge that the Anthropocene Fixed Income Institute has collected over the last four years.** In the 44 case studies in the book, we illustrate quantitative and structural analyses with real-world examples. Some conclusions are supportive, some are critical. Our critique, where present, is not intended to harm, but to help improve and scale the market.

Our discussions with asset owners, asset managers, issuers, banks, rating agencies, service providers, academics and journalists have provided the foundation for much of the analysis and many of the conclusions drawn. It is impossible to acknowledge these individually but be assured of our gratitude for your willingness to engage with the Institute. Finally, we would like to extend a special thank you to our philanthropic funders for their generous support. Without them, this work would not be possible.

## Ulf Erlandsson

PhD, CEO and Founder, Anthropocene Fixed Income Institute

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# INTRODUCTION TO SLBS

# 01 INTRODUCTION TO SLBS

## SECTIONS



## CASE STUDIES

"A key strength of the SLB structure is, as we will show, its potential to cater to both purposes."

## 1.1 HOW TO USE THIS BOOK

The purpose of this book is to serve as a broad, practical overview of the nascent sustainability-linked bond (SLB) market, and explore both financial as well as impact motivations for the instrument. A key strength of the SLB structure is, as we will show, its potential to cater to both purposes.

The text will mostly take an investor perspective, reflecting the backgrounds of the authors. Issuers' views will be represented, however, as without them there would be no SLBs for investors to buy and trade. Investors and issuers will always be engaged in a back-and-forth, and this is where the option pricing model, presented in Chapter 2, is crucial for understanding the balance of interests and other dynamics of SLBs. The model holds that an issuer who commits to pay a higher coupon on a bond due to some condition, should be paid an option premium, which in turn translates into a lower initial, fixed coupon.

This model establishes a level playing field between investors and issuers, and creates the conditions for the SLB market to further develop. As it is key to understanding how SLBs are issued and traded, we urge readers to read Chapter 2, on basic pricing. Chapter 2 also discusses financial materiality, using the option premium methodology to create 'greenback SLBs'. Further information on the option pricing model can be found in Chapter 5's review of advanced pricing.

Chapter 3 examines SLBs in the portfolio context. It provides an idealised model of an SLB to better describe its utility as both a source of alpha and risk hedge. The chapter also explores the SLB's role in driving impact and transparency among issuers.

Chapter 4 unpacks the function of sustainability performance targets (SPTs) and coupon step-up/step-down triggers in SLB structures. A core message is that targets should be science-based. Beyond the obvious benefits in terms of impact, this also allows the option pricing effect to play out in full. The chapter discusses technical dimensions of SPTs and price dynamics around trigger dates.

As mentioned above, Chapter 5 goes deeper into SLB pricing. Here we place the conceptual option pricing framework in a fuller context, describing how to price SLBs using risky discount factors as well as by using a stochastic Black-Scholes framework. In other words, we look first at pricing SLBs assuming the issuer might default and not pay the (non-)stepped coupons, and second at pricing SLBs where the probability of an SPT being achieved is defined by a statistical process, rather than guesswork. The chapter includes a series of case studies based on the Black-Scholes framework, but does not require a full understanding of the framework to be useful.

Lastly, Chapter 6 collects a number of more detailed use cases and analyses of SLBs, specifically looking at how the bonds can be used as hybrid capital instruments and how they can facilitate public-private blended finance for sustainability goals. We also address here an oft-uttered critique of SLBs: the ability of issuers to call them before SPT observation dates.

This book does not seek to compete with the many industry outlets providing near real-time, detailed insights into structural developments in the SLB market. What it offers instead is an objective view of the SLB as a financial instrument and an overview and explanation of notable SLB transactions. Some SLBs have been structured poorly, some well, and through more than 40 case studies we endeavour to illustrate which factors differentiate them.

Nothing in this book should be construed as investment or legal advice. Our intention is that it becomes a trusted textbook for practitioners and source of inspiration for SLB structurers.

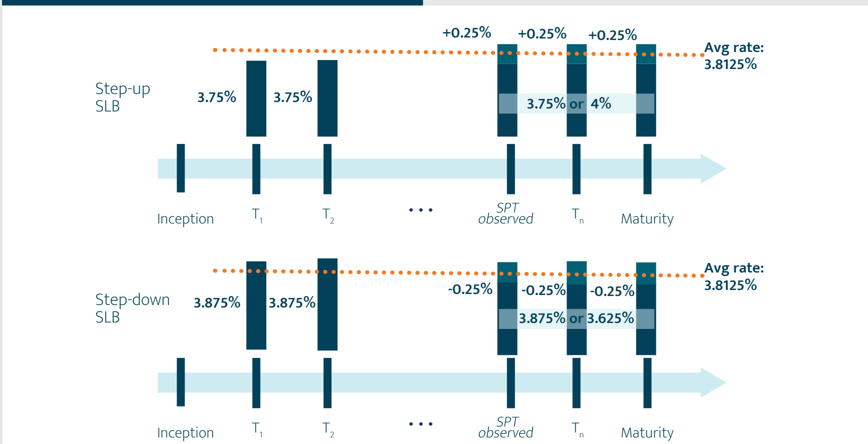
## 1.2 UNDERSTANDING THE SLB STRUCTURE

An SLB is a fixed or floating rate bond where the payment coupons increase or decrease by a predetermined rate at a given point in their term if specific, measurable sustainability objectives are met/not met by the issuer. Achievement of these sustainability objectives is measured using key performance indicators (KPIs) and assessed against predefined sustainability performance targets (SPTs).

A simple overview of SLB structures is provided in Figure 1.1, where the payout structure of an SLB with maturity T is shown. In the step-up version of the bond, the coupon increases by 0.25% from an initial rate of 3.75% if the SPT is not met at the observation date. In the step-down case, the coupon decreases 0.25%, from 3.875% to 3.625%, if the SPT is achieved. If we assume there is a 50/50 chance of the SPT being met, and that the length of the pre- and post-step periods are similar, then the expected interest rate of each structure will be 3.8125%.

Figure 1.2 provides a typical example of an SLB issuance announcement. This defines the relevant yet-to-be-priced dimensions of the structure, such as the coupon steps, the SPTs, and payout periods. From a bond pricing perspective, these dimensions are deterministic, meaning that the value of, for example, a step-up by 25bps[1] in three years' time can be discounted to the present. The "blurb"[2] in Figure 1.2 (titled 'Marketing') is usually preceded by a deal road show (in person or virtually), where the issuer of the bond explains to investors its sustainability strategy, as well as the motivations behind the chosen

**Figure 1.1** A step-up and step-down SLB structure




[1] This book will use the notation 0.25% or 25bps (basis points) interchangeably. 1bp (one basis point) is 1/100th of a percentage point: 1% / 100 = 0.01% ⇔ 0.0001 in decimal form ⇔ 1e-4 in scientific notation.

[2] A new-issue "blurb" is simply the new deal announcement on the Bloomberg (or similar) terminal.

KPIs and SPTs. The investor has to decide the extent to which these metrics and targets are aligned with their own sustainability strategy (if they have one), a process that usually involves some form of second party opinion. More importantly, from a pricing perspective, is the probability investors assign to the issuer actually achieving its SPTs, as this determines how likely it is that the coupon of the bond will adjust.

Schematically, a step-up SLB has two components: a fixed-coupon bond[3] and an option that gives the investor a claim on a different fixed-rate cash flow if the issuer falls short of its SPTs. The value of this embedded option is contingent on three main factors: the probability the SPTs are achieved over the given time frame, the size of the step-up, and the length of time the higher cash flows would be paid for. We will return to the pricing of SLBs in more detail in Chapters 2 and 5. It should be noted, however, that current market practice is not focused on discussing the option value of the SLB. This can be discerned in the proliferation of performance targets in current deals, where two or three targets are commonplace, often with little or no consideration of how these targets correlate or how an investor should assign probabilities to their achievement.

**Figure 1.2** Sample new issue announcement for Deutsche Post SLB

**IPT: Deutsche Post EU500m WNG 10Y SLB MS+85 Area**

- EU500m WNG 10Y SLB Fixed (July 3, 2033) MS+85 Area
    - Coupon: Annual, act/act ICMA
- Issuer: Deutsche Post AG (DPWGR)
- Exp. Ratings: A2/BBB+ (Moody's/Fitch)
- Format: Reg S, bearer, senior unsecured, sustainability-linked bond
- CoC 100, 3-month par call, clean-up call (80%)
- UOP: GCP, refinance existing debt
- Settlement: July 3, 2023
- Denoms: 1k x 1k
- ISIN: XS2644423035
- Bookrunners: HSBC (GC/B&D), Commerzbank, ING, SEB
- Sustainability Performance Targets:
    - SPT for KPI 1: Reducing absolute Scope 1 and 2 GHG emissions by 42% by 2030 from a 2021 base year
    - SPT for KPI 2: Reducing absolute Scope 3 GHG emissions by 25% by 2030 from a 2021 base year
- Step Up Mechanism: If one or both SPTs are not met: Original Interest Rate plus 0.25 percentage points per annum for the interest periods commencing on 3 July 2031 (Interest Rate Step-Up Date) to the Maturity Date
- Marketing: https://www.bourse.lu/issuer/DeutschePost/56012

[3] With "fixed-coupon" we here mean "fixed-coupon increment rate", noting the difference between a *fixed* and *floating* rate bond. In a fixed-rate bond, the coupon change is defined from the initial coupon of the bond. In a floating-rate bond, it is defined as a change in the coupon spread above the underlying floating rate. The very large majority of SLBs so far are in a fixed-rate format.

## 1.3 MARKET OVERVIEW

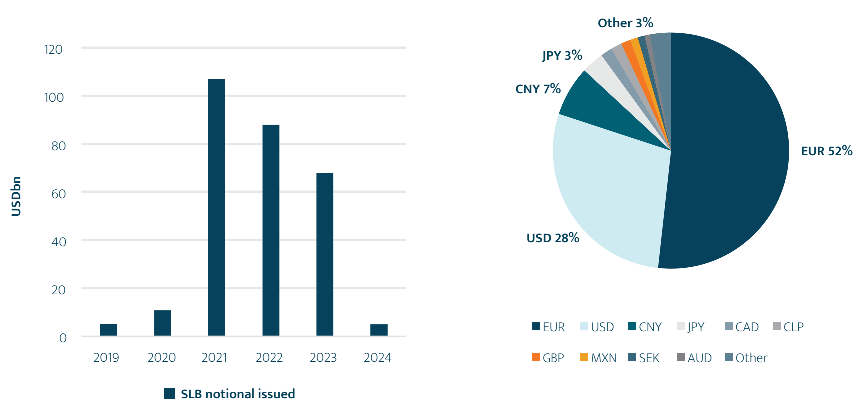
Since the first SLB was issued in 2019 by energy company Enel, the market has grown rapidly. As of December 2023, over USD270bn of SLBs have been issued (see Figure 1.3 below). This is a relatively small amount compared to the use-of-proceeds green bond market, which has witnessed almost USD3tn of issuance since its inception in 2008. In comparison, Figure 1.4, green bond issuance in the 2019-2023 was USD2.4tn: SLB issuance was approximately 10% of green bond issuance. The sheer volume of Sustainability-Linked Loans (USD1.4tn between 2017-2023) indicates the potential of the SLB market. As will be discussed throughout this book, SLBs have great potential to penetrate certain sectors because of the theory of sustainability they represent – one based on issuer-wide change rather than earmarking bond proceeds for specific assets.

In order for the SLB market to thrive, its advantages need to be better understood and communicated. SLBs are different from, but can complement, Green, Social, and Sustainable (GSS) bonds. The latter are use-of-proceeds (UOP) instruments, whereas the former are issued for general corporate purposes (GCP). This means that instead of earmarking funds for specific projects, they emphasise the issuer's overall environmental impact, such as organisation-wide carbon emissions. This broader approach allows for a more extensive range of investments, catering to sectors that may otherwise find it challenging to attract 'green' capital.

Europe is at the forefront of both SLB and green bond issuances, accounting for 56% and 57% of global issuances, respectively, since 2007. However, the landscape is evolving. Sovereigns like Chile and Uruguay have recently ventured into the SLB market. In the Asia-Pacific region, there's a noticeable gap between green bond and SLB issuance, indicating a vast potential for growth as the SLB structure becomes more familiar. Conversely, emerging markets outside Asia are becoming SLB powerhouses, surpassing even North America in adoption. Brazil, Israel and Mexico are especially active SLB issuance hubs.

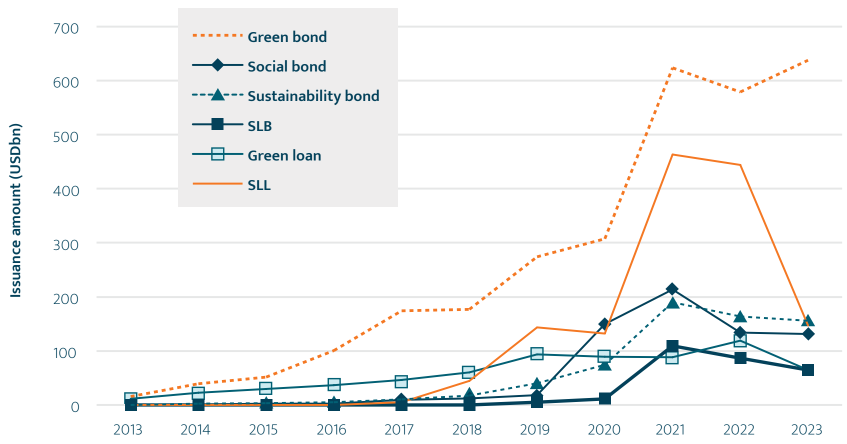
SLBs have a diverse issuance base among corporates, including those in hard-to-abate sectors which struggle to attract traditional 'green' capital but are essential for the climate

**Figure 1.3** (left) SLB issuance by year; (right) and currency




SOURCE: Bloomberg

**Figure 1.4** Issuance amounts across GSSS bonds and loans



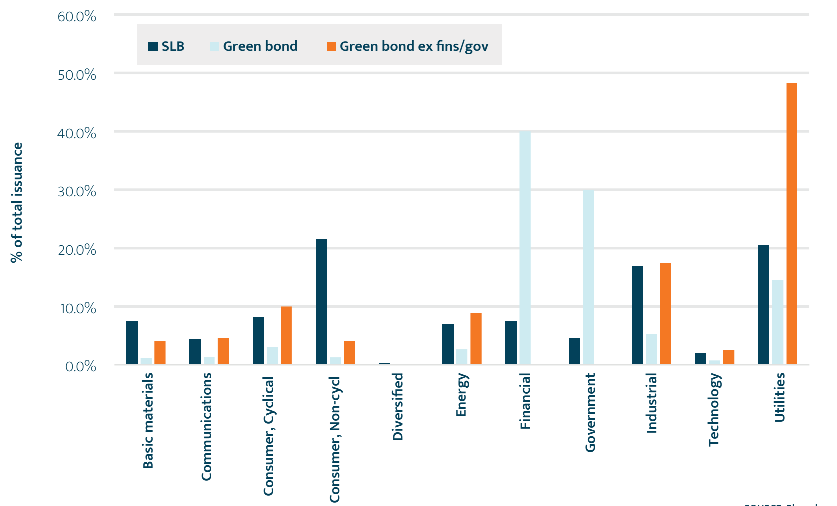

SOURCE: SEB

transition. Whereas 70% of green bonds are issued by financials and governments (as opposed to non-financial corporates), for SLBs the share is just 12%. Figure 1.5 provides a sector breakdown for both SLBs and green bonds, which highlights the SLB market's heterogeneous issuance base. SLB issuers have also historically had lower credit ratings than issuers of green bonds, as shown in Figure 1.6. Whereas the bulk of green bond issuance has come from companies with ratings of A and higher, the majority of SLB issuance belongs in the BBB bucket. A significant proportion of SLBs have also come from sub-investment grade companies (rated BB+ and lower).

**Table 1.1** Top 10 issuers of SLBs nominal amount issued

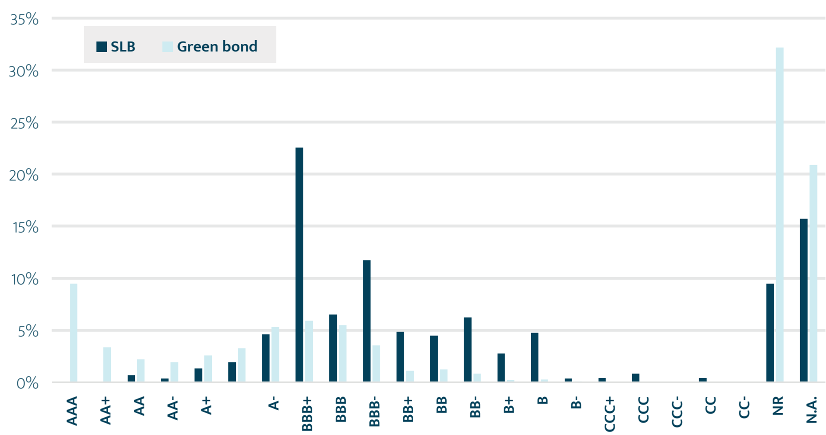
| ISSUER | TICKER | LATEST STANDARD SLB ISIN | LATEST ISSUANCE DATE | COUNT OF SLBS | TOTAL SLB ISSUED (USDBN) | RATING | SAMPLE AFII RESEARCH |
|---|---|---|---|---|---|---|---|
| ENEL | ENELIM | XS2589260723 | Feb 23 | 30 | 31.1 | BBB | **Enel** |
| CHILE | CHILE | US168863DZ80 | Jul 23 | 6 | 10.2 | A- | **Chile** |
| TEVA PHARM | TEVA | XS2592804434 | Mar 23 | 8 | 7.5 | BB- | |
| ENI | ENIIM | XS2623957078 | May 23 | 4 | 5.2 | BBB+ | **Eni** |
| ENBRIDGE | ENBCN | CA29251ZBZ95 | May 23 | 5 | 5.1 | BBB+ | **Enbridge** |
| CARREFOUR SA | CAFP | FR001400LUK3 | Nov 23 | 5 | 3.9 | BBB | **Carrefour** |
| ASTM SPA | ATIM | XS2412267358 | Nov 21 | 3 | 3.4 | BBB- | |
| TELUS CORP | TCN | CA87971MCC51 | Sep 23 | 5 | 3.3 | BBB | |
| FORVIA | EOFP | XS2553825949 | Nov 22 | 3 | 3.2 | BB | |
| SUZANO | SUZANO | US86964WAL63 | Sep 21 | 3 | 2.8 | BBB- | **SLB dynamics** |

**Figure 1.5** Corporate issuance of SLBs and green bonds across sectors and rating categories




SOURCE: Bloomberg

**Figure 1.6** Corporate issuance of SLBs and green bonds across sectors and rating categories




SOURCE: Bloomberg

One explanation for this is the perceived requirement that a green bond issuer must have sufficient assets to justify the use of proceeds. Smaller companies without an appropriate 'green' asset pool are locked out of at least benchmark (USD250mn+) green bond issuance. An SLB, in contrast, does not need a sizable 'green' asset pool.

In addition, green bonds usually aim to have the lion's share of proceeds allocated within two years of the issuance, whereas SLB targets are usually farther out. It can be argued that SLBs are better for targeting capital expenditure or outcomes further into the future. An example of combinations of green bonds and SLBs indicative of this is available in Chapter 3, Case study 12.

Corporates in the energy and industrial sectors are natural proponents of SLBs, as they urgently require capital for transitioning their business models and prefer the flexibility and whole-of-business scope of the SLB structure. Energy companies Enel and Eni and fossil fuel pipeline company Enbridge are the three largest SLB issuers in the hard-to-abate sectors, see Table 1.1. However, drug maker Teva Pharmaceutical Industries, infrastructure giant ASTM, and retailer Carrefour have all also issued more than USD2.5bn each of SLBs, reflecting the instrument's cross-sector appeal.

Corporates have brought to market SLBs with an array of step-ups, KPIs, and other features. Given this diversity of issuance, it is hard to define a 'typical' corporate SLB. Nonetheless in Case 1 we provide Deutsche Post's 2023 instrument as an example, highlighting how its KPIs have evolved against its targets over time.

We provide another example of a hypothetical issuance by auto-manufacturer Nissan in Case 2, which illustrates the potential for investors to request certain sustainability commitments from the companies they invest in – so-called 'active engagement.'

Both these examples cover carbon emissions-related KPIs, which are common among SLBs. Chapter 3 elaborates on other varieties of KPIs. It also discusses SLB trigger points; those occasions in a bond's life that determine whether or not its coupon will change.

The case studies moreover exemplify the perspective of viewing the SLB in terms of optionality.

## CASE STUDY 1
## AN EXAMPLE CORPORATE SLB ISSUANCE: DEUTSCHE POST SLB

**RESEARCH: DEUTSCHE POST SLB: DOES IT DELIVER? JUN 2023**

**BOND: DHLGR EUR3.375% 07/33 (XS2644423035)**

Deutsche Post, a German logistics company rated A-, issued its first SLB on June 26, 2023. Group emissions, which include those from international logistics brand DHL, are driven by transport, predominantly air and road travel. The SLB commits Deutsche Post to reduce overall emissions to target levels verified by the Science Based Targets initiative (SBTi).

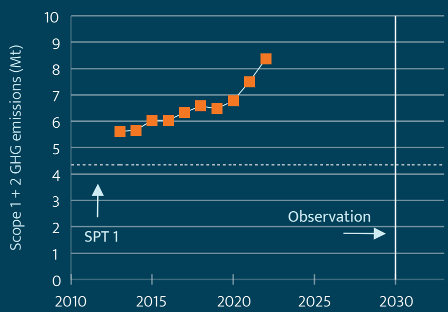
The bond has a ten-year term (maturing in 2033) and a coupon step-up of 25bps if the company misses either one of two SPTs.

Each SPT is linked to KPIs covering the company's greenhouse gas emissions. The first SPT commits Deutsche Post to reduce its absolute level of Scope 1 + 2 GHG emissions by 42% by 2030, with 2021 as the base year, as illustrated in Case figure 1.1. The second SPT calls for a 25% reduction in Scope 3 emissions, as in Case figure 1.1. The magnitude of Deutsche Post's Scope 3 emissions was, at the time of issuance, three times greater than that of its Scope 1 + 2 emissions.

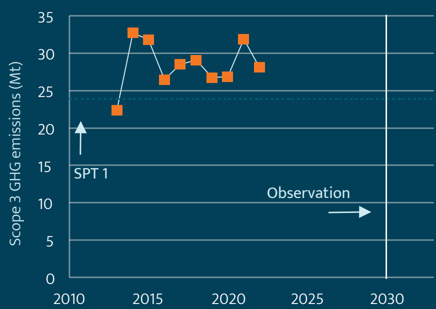
**AFII TAKEAWAYS ON THIS STRUCTURE ARE AS FOLLOWS:**

- The structure offers strong sustainability targets — material KPIs combined with ambitious SPTs. It is encouraging to see this in the transport sector, where highly-rated issuance has been low.
- The coupon step structure is less compelling. A distant observation date means few potential coupon payouts and the bond does not meet our threshold for a financially material transaction (a 'greenback SLB' - see Chapters 2 and 4 for discussion on what constitutes financially material).

The ambitious SPTs translate to an option value of 4.5bps: initial price talk on the bond was ms (mid swaps)+85 (see Figure 1.2 above) but the deal eventually priced substantially higher at ms+45. On a relative value basis, the vanilla DHLGR EUR1% 07/2032s were at the time trading at a z-spread at almost 0bps but widened on the SLB announcement to trade at around z+20. Still, this indicates that the EUR3.375%s came quite cheap, even without accounting for the 4.5bps option value.




**Case figure 1.1** Scope 3 emissions and targets




**Case figure 1.2** Scope 1+2 emissions and targets

# CASE STUDY 2
## PROPOSED SLB FOR NISSAN

**RESEARCH: NISSAN: SHIFT EXPECTATIONS WITH AN SLB? FEB 2023**

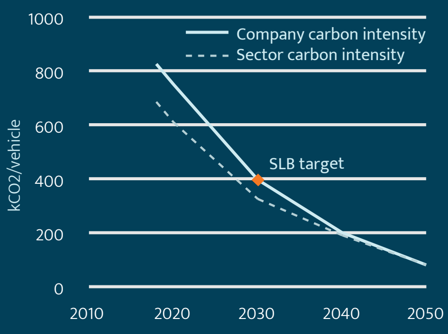
**Nissan has issued two thematic bonds and a green loan under its existing framework, and they appear to have been very well received by investors. Automakers are an attractive sector for global investors looking for SLBs. Auto manufacturing emissions are significant, while the transition to electric vehicles has the potential to drastically lower global emissions.**

**There are science-based targets available to Nissan to help it decide on the KPIs and SPTs to use as part of a hypothetical SLB. Nissan reported a carbon intensity of 0.56 t-$CO_2$/vehicle produced in 2021. According to SBTi's Sectoral Decarbonization Approach method (SDA) for Vehicle Manufacturing (PLDV), which relies on the B2DS scenario of the International Energy Agency (IEA), the 2030 target for Nissan's Scope 1 + 2 should be 0.40 t-$CO_2$/vehicle by 2030 if it wants to achieve net zero by 2050.**

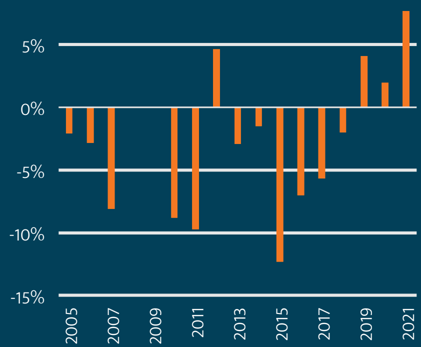
**Nissan's historical data can also be used as input for pricing. Case figure 2.1 shows Nissan's self-reported carbon intensity data. On average, the carbon intensity (Scope 1 + 2) per vehicle produced decreased by -2.63% over the 2005-2021 period, with a standard deviation of 5.32%. This suggests that a statistical approach can be used to estimate the probability of Nissan hitting the SBTi sectoral target levels.**

**SUGGESTED STRUCTURE:**

- **Reduce carbon intensity per vehicle from 0.56 t-$CO_2$/vehicle in 2021 to 0.49t-$CO_2$ in 2025.**
- **Observation date: December 31, 2025.**
- **Coupon step-up: 50bps (accruing from March 2026).**
- **Settlement: March 2023.**
- **Final maturity: March 2028.**




**Case figure 2.1** Carbon intensity (kg CO2e/vehicle) pathway as per Science-Based Target Initiative




**Case figure 2.2** Year-on-year change in carbon intensity (Scope 1 + 2) per vehicle produced by Nissan

Among sovereigns, while many have embraced GSS bonds, few have issued SLBs. However, two Latin American countries have established themselves as pioneers in this space: Chile and Uruguay.[4]

Chile first entered the market with a USD2bn 20-year deal in 2022 (see Case 3). This initial SLB has two KPIs: one related to greenhouse gas (GHG) emissions and the other tied to increasing renewable energy in electricity generation. In June 2023, Chile placed three SLBs: USD1.15bn of 12-year paper, USD1.1bn of 30-year paper, and EUR0.75bn of 11-year paper. This made Chile at the time the second biggest issuer of SLBs, only behind Enel.

Chile's 2023 vintage retained the GHG reduction KPI and debuted a new KPI targeting 40% female board representation by 2031. The new KPI is weakly correlated with the GHG reduction KPI, offering potential for higher option value and better pricing for the issuer.

The second sovereign issuer, Uruguay, issued a USD1.5bn SLB in October 2022. This has a unique structure where the bond's coupons can either step-up or step-down based on two KPIs: one linked to GHG emissions, and another to maintenance of native forest area. Each KPI has an upper and lower target. The bond pays a step-up coupon if the KPI is above the upper target, and a step-down if below the lower target.

SLB structures may be preferable to GSS bonds for other sovereigns that are looking to finance their climate transition plans.[5] Three factors recommend them for this purpose. Firstly, SLBs offer greater flexibility. Unlike 'transition bonds', where the UoP are tied to specific technologies determined prior to issuance, an SLB allows a sovereign issuer to invest in a range of decarbonisation approaches over time. This is a useful feature given that some transition technologies that look attractive today might not prove to be cost effective in future.

Secondly, SLBs emphasise the end goal – GHG reduction – rather than the initial investment amount. By linking financing to carbon reduction targets through an SLB, an issuer demonstrates to investors its long-term commitment to climate action. This approach would have the added benefit of ensuring sovereign environmental commitments extend beyond electoral cycles, because any policy changes that deviate from these commitments could lead to increased financing costs, ensuring a level of accountability.

Lastly, sovereign SLBs have proven to be more attractive to global investors than transition-focused instruments, where some of the technologies, for example ammonia-coal co-firing, may be out of scope for investors.

A case study of a hypothetical sovereign SLB for Japan is provided in Chapter 3. In Chapter 6, we will further discuss the topic of structuring sovereign SLBs with credit support, which seems a promising avenue for involving developing markets with blended finance structures. A case of a quasi-sovereign has been seen with Rwanda which is now looking to issue on the sovereign level as well.[6] At the time of publication, there have also been indications that Kenya is looking to issue in a pure sovereign format too.[7]

[4] The sub-/supra-sovereign segment has been inactive in direct issuance, but has invested in SLBs themselves, e.g. the European Bank for Reconstruction and Development (EBRD), "EBRD invests in sustainability-linked bond in Poland", EBRD press release, December 21, 2022.

[5] See for example "The potential of sovereign sustainability-linked bonds in the drive for net-zero", Lehmann, A. and Martins, C., Bruegel Policy Brief, 23 Mar 2023, and "The understated benefits of sovereign sustainability-linked bonds", SSDH, 25 Oct 2023.

[6] "Rwanda considering sovereign SLB after development bank success", Environmental Finance, 23 Apr 2024.

[7] "Kenya to Debut $500 Million Sustainability-Linked Bond", Bloomberg, 17 Apr 2024. The article indicates that the bond would be issued in the second half of 2024.

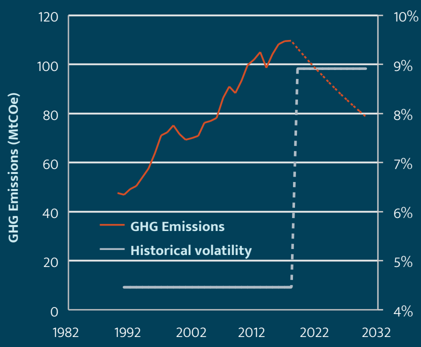
## CASE STUDY 3
SOVEREIGN SLBS: CHILE

**RESEARCH: CHILE SUSTAINABILITY-LINKED BOND: OPTIONALITY ANALYSIS, APR 2022**

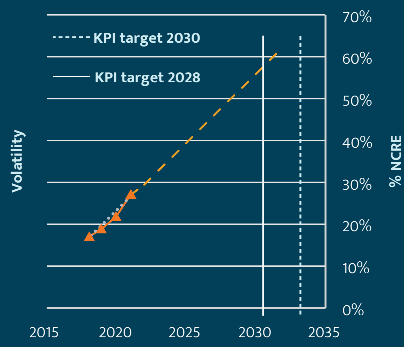
**BOND: CHILE USD4.34% 03/42 (US168863DY16)**

Chile was the first country out of the Americas to issue green bonds, and was the first globally to issue in an SLB format, in March 2022. The bond's SPTs cover a) a reduction of GHG emissions under a total emissions budget constraint, and b) an increased share of renewable electricity generation to 60% by 2032.

According to our analysis, the SPTs and KPI were robust, especially the cumulative emission reduction target. This avoids the situation with other sovereigns (such as the UK and Sweden) where long-dated targets are fixed but short-to-intermediate term emissions increase, thereby back-loading the bulk of decarbonisation. Step-ups of 12.5bps are tied to each of the SPTs independently, which may be paid from 2034 until the bond's maturity. The relatively long maturity and payout time (eight years), is another positive commitment in this bond structure.




**Case figure 3.1** KPI1 – Chile GHG emissions since 1990, projected emissions according to NDC and expected volatility




**Case figure 3.2** KPI2 – Data points on Chile renewable energy generation proportion with extrapolated linear trend

**FURTHER RESEARCH: OFFI-CHILE THE LARGEST SOVEREIGN SLB ISSUER; UNDERSTANDING DYNAMICS BETWEEN SUSTAINABLE AND TRADITIONAL DEBT; CHILE PESO SLB ISSUANCE**

Sovereigns have issued other innovative financial instruments with alternative pay-outs or conditions. Examples include Ecuador's debt-for-nature swap[8] and South Africa's 'Rhino bond.'[9] These are not normally categorised as SLBs although they share certain attributes. Chapter 3 further explores SLB structures with alternative payouts.

### 1.3.1 NON-VANILLA BOND FORMATS

Most SLBs have been issued as 'vanilla' instruments.[10] However, some recent issuances have catered for different capital and funding needs. These include SLBs structured as corporate hybrids, convertible bonds, and bank funding vehicles.

#### 1.3.1.1 HYBRIDS

The most significant corporate hybrid SLB to date is the STTDGC SGD5.7% PerpNC30 (SGXF26579122), issued by Singapore's ST Telemedia Global Data Centres in January 2024. This has a 2028 trigger date, at which time a step-up will occur if the issuer does not have a sufficiently high renewable energy consumption rate.[11] This bond is analysed in Chapter 6. Corporate hybrids with SLB features are few and far between, as the traditional equity credit an issuer gets for a hybrid bond does not allow for coupon step-up in the eyes of the all-important rating agencies.[12] Another consideration from the investor perspective is how likely a hybrid is to be called at the first call date. This would effectively cap the cumulative payouts from any step-up coupon. More on general callability in Chapter 6.

#### 1.3.1.2 CONVERTIBLES

As of September 2023, issuance of convertibles in SLB format amounts to USD2.5bn, split across four companies: ENI, Schneider Electric, Edenred and SPIE.[13] The largest to date is the ENI EUR2.95% 01/2030, at EUR1bn in size. This has relatively short-dated (end of 2025) targets for net upstream carbon footprint reduction and installed renewable energy capacity. A step-up of 50bps applies on failure to hit these targets. The convertible priced with a 20% conversion premium, enabling the issuer to pay a 2.95% coupon rather than the at-the-time standard bond yield of around 4% for the same terms.

A convertible SLB is an interesting structure; if strong sustainability performance is correlated with strong business performance, one would expect convertibility to offer an offsetting hedge to the coupon step-up. If sustainability

**Table 1.2** Performance scenarios for convertible SLB

| | POOR SUSTAINABILITY PERFORMANCE | STRONG SUSTAINABILITY PERFORMANCE |
|---|---|---|
| **POOR EQUITY PERFORMANCE** | STEP-UP COUPON ACTS AS HEDGE AGAINST POTENTIAL SPREAD WIDENING. LOSS ON CONVERTIBILITY OPTION AS EQUITY CORRELATED TO SUSTAINABILITY | LOSS ON SLB OPTION HEDGE BUT BENEFIT FROM POTENTIAL SPREAD TIGHTENING. LOSS ON CONVERTIBILITY OPTION AS EQUITY NOT CORRELATED TO SUSTAINABILITY |
| **STRONG EQUITY PERFORMANCE** | STEP-UP COUPON ACTS AS HEDGE AGAINST POTENTIAL SPREAD WIDENING. BOND CONVERTS TO EQUITY, ON RALLY WHERE EQUITY NOT CORRELATED TO SUSTAINABILITY | LOSS ON SLB OPTION HEDGE BUT BENEFIT FROM POTENTIAL SPREAD TIGHTENING. BOND CONVERTS TO EQUITY ON RALLY WHERE EQUITY CORRELATED TO SUSTAINABILITY |

8 "Ecuador seals record debt-for-nature swap with Galapagos bond", Reuters, May 9, 2023

9 "Wildlife Conservation Bond Boosts South Africa's Efforts to Protect Black Rhinos and Support Local Communities", World Bank press-release, 23 Mar 2022.

10 One non-vanilla feature that has been debated has been callability: we study this in Chapter 6 at length.

11 See "Sustainability-linked bond bumper week", AFII, 11 Sep 2023 for a further analysis, specifically on CNY hybrids and the treatment of equity credit among rating agencies.

12 For a longer discussion, see "The missing market: sustainability-linked hybrids", GlobalCapital, 11 Jan 2024.

13 See "Sustainability-linked bond bumper week", AFII, 11 Sep 2023 for a further analysis.

performance is poor, an investor receives the step-up as a hedge to protect against losses driven by associated spread widening. If sustainability performance is strong, an investor does not receive the step-up but, upon an equity rally, they will be able to convert their security into shares to benefit from the company's improvement.[14] See Table 1.2 for all scenarios.

### 1.3.1.3 FINANCIALS FUNDING STRUCTURES

SLBs as funding instruments for bank loans are exceedingly rare among lenders outside China. This is despite strong uptake of sustainability-linked loans (SLLs): the SLL market actually preceded the SLB market, with the first deal, a EUR1bn arrangement concerning Dutch company Philips, taking place in 2017.[15]

One potential reason is that the use of step-ups in bond structures does not align with regulators' views on bank capital. An alternative approach was pioneered by Nordea (see Case 4) where a basket of SLLs were defined as the UoP for a vanilla bond.

Swedish private equity manager EQT AB[16] (Ticker: EQT SS) is the only asset manager to our knowledge that has issued SLBs. Indeed, all of EQT's bonds have been issued as SLBs. The first round of EUR0.875% 05/2031s (XS2463988795) paper were issued with a series of weak SPTs. However, more recent issuances (EQTSS EUR2.375% 04/2028, XS2463988795, and EUR2.875% 04/2032s, XS2463990775) are linked to EQT's goal of having more than 60% of its portfolio companies holding SBTi -approved targets by 2025. This approach is novel in its attempt to drive sustainability performance in private markets. However, the relatively low threshold on alignment allows for quite significant 'tails' of under-performing companies.[17]

[14] We cover risk management of non-convertible SLBs in "Understanding dynamics between sustainable and traditional debt", AFII, 26 Jan 2023

[15] "ING and Philips collaborate on sustainable loan", ING company website, 19 Apr 2017.

[16] EQT AB not to be confused with US fossil gas company EQT Corporation (EQT US).

[17] "EQT Infrastructure investors and off-shore capital raising for Adani Group" discusses EQT's involvement with the Adani Group's coal activities, as an example.

# CASE STUDY 4

## ALTERNATIVE SLB FORMAT, FINANCING BANK SLLS: NORDEA

**RESEARCH:** NORDEA SLLB: DRIVING FOR A SUSTAINABILITY-LINKED FUTURE, OCT 2023

**BOND:** NDAFH EUR4.375% 09/26 (XS2676816940), NDAFH SEK3.78% 09/25 (XS2532378721)

In June 2022, Nordea, a Scandinavian bank headquartered in Helsinki, unveiled its Sustainability-Linked Loan Funding Framework. This was designed to allocate capital to fund sustainability-linked loans (SLL) on Nordea's balance sheet, based on certain eligibility criteria. As a result, it was termed a "Sustainability-Linked Loan Bond" (SLLB). The SLLB is a pioneering move in the sustainability-linked debt market. It offers sustainability-linked investment opportunities to institutional investors, a market segment that traditionally lacked such exposure. To ensure transparency and credibility, an external review verifies the eligibility of the funded SLLs. This is crucial as the SLL market is largely private and opaque, and has faced criticism for lacking ambition and materiality. For an SLL to be funded, it must align with the the ICMA Sustainability-Linked Loan Principles from its signing year, contribute positively to climate change mitigation, and have its KPIs and SPTs externally reviewed and deemed "material" and "ambitious".

Nordea issued SLLBs worth SEK2.8bn and NOK1.3bn under this framework, with durations of three and five years. In August 2023, the bank priced a EUR1bn three-year bond, which tripled the total volume of SLLBs in circulation. This large euro-denominated deal in 2023 brought more attention to the framework.

The SLLB structure brings greater transparency to the SLL market and should help distribute SLLs to a broader investor universe.

| ISIN | COUPON | PRICING DATE | MATURITY | CURRENCY | AMOUNT OUTSTANDING (CCY MN) | AMOUNT OUTSTANDING (USDMN) |
|---|---|---|---|---|---|---|
| XS2532378721 | 3.780% | 06-Sep-22 | 15-Sep-25 | SEK | 2,100 | 191 |
| NO0012697814 | 5.850% | 06-Sep-22 | 15-Sep-27 | NOK | 800 | 75 |
| XS2532378051 | FLOAT | 06-Sep-22 | 15-Sep-25 | SEK | 700 | 64 |
| NO0012697822 | 4.655% | 06-Sep-22 | 15-Sep-27 | NOK | 500 | 47 |
| XS2676816940 | 4.375% | 30-Aug-23 | 06-Sep-26 | EUR | 1,000 | 1,055 |

**Case table 4.1** Nordea SLLB issuance details

### 1.3.1.4 SUKUKS

Sukuk is the market terminology for sharia-compliant bonds. Under Islamic law, interest payments are prohibited. Sukuk instruments are therefore typically structured as Special Purpose Vehicles (SPV) that represent ownership of real assets, allowing holders to receive returns in the form of profit share or rent, rather than as interest.

Green sukuks are those where the UoP is typically ring-fenced for investments in renewable energy, thereby addressing sharia law's provisions on protecting the environment.

Despite recent growth, it has been reported that there is significant unmet demand.[18,19]

While in theory, guidance on SLB sukuks does not preclude the paying of a coupon step-up,[20] the first SLB sukuk used an alternative payout structure.

## CASE STUDY 5

SUKUK SLBS: ETIHAD

**RESEARCH:** **SUSTAINABILITY-LINKED BONDS: ALTERNATIVE STEPS, MAY 2023**

**BOND:** **UNITYL USD2.394% 11/25 (XS2245508044)**

**The first sustainability-linked sukuk (ISIN: XS2245508044) was issued by Etihad Airways in November 2020.[18] The KPI is the emissions intensity of its entire fleet, with a target reduction of 17.8% by Dec 2024, measured against a 2017 baseline. If this target is missed, the issuer will purchase an amount of carbon offsets in line with the degree of undershoot. We note that these carbon offset purchases are additional to any commitments already made by Etihad under the Carbon Offset and Reduction Scheme for International Aviation (CORSIA), which commits airlines to offset total post-2020 absolute emissions. The bond was only slightly oversubscribed, compared to reports of multiple over subscriptions of green sukuk issuance in Malaysia and Indonesia, but does represent an innovation in the sukuk market.**

**Purchasing carbon offsets rather than providing an interest rate step-up and other alternative payment structures are discussed in Chapter 4.**

**At the time of publication of this book, ICMA together with the Islamic Development Bank and LSE Group had just launched "Guidance on green, social and sustainability sukuk" that is also likely to have spillover effects on sustainability-linked sukuk structures.**

[18] "Etihad's USD600 million sustainability-linked sukuk: the first of many things", Natixis, 30 Nov 2020.

[18] "COP27: Islamic capital markets can take the lead", Norton Rose Fulbright, Nov 2022.

[19] "Green Sukuk", Climate Bonds Initiative, accessed 4 May 2023.

[20] "Sustainable Sukuk", World Bank Group, Nov 2021.

## 1.4 CAPITAL MARKETS ACTIVITY

As noted in the previous section, banks are in general not tapping the SLB market as a source of capital. However, they do (naturally) play an important role facilitating SLB deals between other issuers and investors.

Table 1.3 ranks banks according to the amount of league-table eligible SLB issuances they have participated in.[21] It also tabulates estimated fees from these issuances, which we argue is a better way to gauge the extent of their activities. The final column, 'AFII alignment ranking', looks at net green and fossil funding and orders banks across three tiers: "top", "mid", and "bottom." A "top" tier ranking indicates a bank with a large amount of green fee revenues relative to fossil fuel fee revenues.

European banks are well represented among those with the highest SLB fee intakes as percentage of total fees, while US, Canadian, and Japanese institutions are more likely to generate the bulk of their fees from fossil fuel deals than sustainability-linked ones.

**Table 1.3** Bank league table for SLBs (league-table eligible deals only), 2020-2023. Source: Bloomberg, AFII.

| BANK | SLB CREDIT ALLOCATION USDmn | SLB FEES USDmn | TOTAL FEES USDmn | SLB FEES OF TOTAL | AFII ALIGNMENT RANKING |
|---|---|---|---|---|---|
| BNP PARIBAS | 17,945.8 | 104.7 | 7,304.5 | 1.4% | TOP |
| HSBC | 15,166.4 | 92.8 | 6,375.7 | 1.5% | TOP |
| CREDIT AGRICOLE CIB | 14,787.1 | 105.9 | 4,766.6 | 2.2% | TOP |
| JP MORGAN | 14,652.7 | 83.3 | 13,615.6 | 0.6% | MID |
| SOCIETE GENERALE | 12,218.5 | 73.5 | 3,262.2 | 2.3% | TOP |
| BOFA SECURITIES | 11,873.3 | 68.4 | 12,025.7 | 0.6% | MID |
| CITI | 10,591.2 | 68.7 | 10,042.3 | 0.7% | MID |
| MORGAN STANLEY | 9,817.6 | 62.6 | 6,180.3 | 1.0% | MID |
| UNICREDIT | 9,231.5 | 53.5 | 2,431.9 | 2.2% | MID |
| GOLDMAN SACHS | 9,195.5 | 64.3 | 7,164.9 | 0.9% | MID |
| BANCO SANTANDER | 8,784.9 | 53.5 | 2,771.0 | 1.9% | MID |
| DEUTSCHE BANK | 8,779.6 | 62.8 | 6,729.8 | 0.9% | MID |
| BARCLAYS | 7,323.9 | 46.3 | 6,908.2 | 0.7% | MID |
| MIZUHO FINANCIAL | 7,072.4 | 42.8 | 4,095.6 | 1.0% | BOTTOM |
| MUFG | 6,351.4 | 43.7 | 3,803.8 | 1.1% | BOTTOM |
| NATIXIS | 6,057.9 | 48.5 | 2,150.8 | 2.3% | MID |
| UBS & CREDIT SUISSE | 6,058.8 | 42.5 | 7,525.3 | 2.5% | TOP |
| ING GROEP | 5,483.0 | 38.1 | 2,325.2 | 1.6% | MID |
| SMBC | 5,377.4 | 28.6 | 3,571.4 | 0.8% | MID |
| BBVA | 5,278.8 | 34.5 | 1,297.4 | 2.7% | N.A. |
| INTESA SANPAOLO | 4,736.2 | 36.6 | 1,493.2 | 2.5% | BOTTOM |
| RBC CAPITAL MARKETS | 4,590.7 | 28.6 | 4,429.2 | 0.6% | BOTTOM |
| BMO CAPITAL MARKETS | 4,560.8 | 19.8 | 2,830.7 | 0.7% | BOTTOM |
| SCOTIABANK | 3,957.7 | 19.7 | 2,763.8 | 0.7% | BOTTOM |
| COMMERZBANK | 3,840.5 | 20.9 | 1,293.0 | 1.6% | TOP |
| STANDARD CHARTERED BANK | 3,586.8 | 18.5 | 2,381.5 | 0.8% | BOTTOM |
| BANK OF CHINA | 3,184.3 | 21.4 | 6,562.6 | 0.3% | N.A. |
| DBS GROUP | 2,874.5 | 21.1 | 962.7 | 2.2% | N.A. |
| WELLS FARGO | 2,778.3 | 18.5 | 5,795.5 | 0.3% | BOTTOM |
| SEB | 2,744.7 | 22.3 | 1,032.1 | 2.2% | TOP |

[21] Smaller deals and deals away from the main currencies tend to be non-eligible. Refer to "The Box: a tool for bank influence" for more detail on this type of analysis.

## 1.5 MAIN CRITIQUES OF SLBS

The rapid growth of SLBs has been met with increasing criticism of the structures employed. Complaints conform to one of two types: the ambition of SPTs and KPIs used and the value of coupon step-up rates. We define the former as sustainability materiality and the latter as financial materiality.

*Sustainability materiality critique:* Insufficiently ambitious SPTs and/or inadequate KPIs are less likely to drive significant sustainability improvements by the issuer, and will make the SLB less compelling for investors seeking to achieve impact and/or particular outcomes.

*Financial materiality critique:* SLBs with insubstantial penalty rates or unclear step-up mechanisms are harder to differentiate on price vis-a-vis vanilla bonds, and the issuer may lack sufficient financial incentives to attempt to achieve the associated SPTs.

The following list highlights different versions of these two critiques:

### 1. Lack of pricing benefit to issuers:

*There is little pricing benefit for issuers to recoup the costs of setting up a sustainability-linked bond structure.*

Historically, this has been true, as there have been few reasons to price the optionality in SLB structures. With more robust structures, a clear pricing advantage and lower cost-of-capital should be achieved if SPTs are met.

Chapters 2 and 5 explore the option pricing approach and reveal how SLBs provide substantial de risking and pricing benefits to issuers.

### 2. Unambitious sustainability targets:

*Sustainability performance targets set by issuers are not challenging enough.*

SLB issuers that have set ambitious targets have historically not been rewarded with lower costs of funding, and have been stigmatised when they have failed to achieve these. This means issuers have little incentive to set ambitious targets in the first place. However, ambition level is – or should be – mathematically linked to pricing benefits and incentives (see Chapter 2).

Chapter 4 provides an overview of targets and discusses how to set robust SPTs. Moreover, it argues for a scientifically well-grounded approach, connected with the forecastability required for SLBs to achieve pricing and de-risking benefits.

### 3. Small coupon steps and weak incentives/ hedging capacity

*The use of small coupon steps means that a step-up event is financially immaterial to an issuer. This provides a weak incentive to achieve targets. It also means that the SLB does not provide enough of a hedge on sustainability performance for investors.*

Without potential pricing benefits, it is hard to see why coupon steps should be any larger than what is needed to place a bond in the market. Again, applying a pricing framework should remedy this failing, as discussed in Chapter 3. Chapter 2 offers perspectives on why SLBs, if priced robustly, can add substantial value to investor portfolios.

### 4. Complexity:

*Multiple, hard-to-calculate KPIs; lack of observation reporting dates and other operational complexities make it too resource-demanding for investors to track SLBs.*

The SLB market is new and one should not be overly surprised that there are tuning difficulties when it comes to legal documentation and the structuring of certain features, which can load unwanted costs on investors. Parsimony is a red thread that runs through Chapters 2, 4, and 5, and should steer readers toward structures that are less resource intensive to monitor.

### 5. Callability:

*Many SLBs are callable before their first trigger date.*

As we show in Chapter 7, callability does not seem to be a material concern for the market.

### 6. Ineligibility for 'labelled' funds/strategies

*SLBs are not accounted for as traditional green bonds, making them ineligible for dedicated green funds and/ or strategies.*

The low ambition of many SLBs, coupled with scant financial incentives, have led some investors to shun SLBs and exclude them from 'green' strategies. We argue that well-structured SLBs have a clear role to play as transition instruments and should be considered for inclusion in certain climate/sustainable labelled funds. We argue that robust SLBs should definitely be eiligible for frameworks such as the European Union's SFDR Article 8 and 9.

Many of these critiques stem from the lack of pricing differentials between SLBs and traditional bonds. If an SLB does not provide a differentiated enough structure — or if the difference is not being priced — then the issuer and investor rationale for pursuing such instruments is negligible.

However, some of these critiques are related to the newness of the SLB market. Many of the problematic features noted above are likely to be ironed out over time through various stakeholder activities, as well as natural market development.

The following chapters will address many of these critiques. Though SLBs can appear highly technical, their core purpose is to align sustainability and financial outcomes in new and alternative ways than other 'green' instruments. This should not be forgotten by the reader. To borrow the words of Jon Hay at GlobalCapital:[22]

"The SLBs will have got investors — and therefore companies — talking and thinking and caring about their core sustainability targets, whether they are going to be achieved and whether they are ambitious.

What is sustainable investing if not that?"

[22] "In defence of SLBs", GlobalCapital, 4 April 2023.

## SOME OPINIONS FROM AROUND THE INDUSTRY

"To get back to growth in 2023 and beyond, issuers of SLBs will have to find ways to address concerns flagged by market participants about the credibility of SLBs, namely surrounding issuer ambitions and incentives to achieve sustainability targets."

**S&P** FEB 2023

"[In 2022] sustainability-linked bonds did not see a continuation of the halo effect it saw in 2021."

**HSBC** FEB 2023

"Companies are getting something for nothing: cheaper financing and an enhanced green reputation come without any real effort to deliver on climate goals and no chance of financial penalty."

**BLOOMBERG** OCT 2022

"An enduring catch-22 is that when step-ups do happen, they can look bad for investors who buy SLBs in part to hit green financing targets."

**FINANCIAL TIMES** FEB 2023

"The breakout in SLB issuance observed in recent quarters will also likely continue given the challenges that some EM issuers face in having a sufficient amount of eligible projects to support benchmark use-of-proceeds sustainable bonds"

**MOODY'S** JUN 2023

"The potential issuance in the SLB space is essentially capped by the amount of issuers that have an ESG target – which, of course, is a number that's ever growing"

**BARCLAYS** APR 2024

"SLBs are fostering a dialogue between issuers and investors on the transition – and that to me is the additionality of SLBs."

**SPEAKER, ENVIRONMENTAL FINANCE,**
**UNION INVEST/ENVIRONMENTAL FINANCE** APR 2023

"For investors, SLBs are inherently superior to ordinary bonds."

**GLOBAL CAPITAL OP-ED "IN DEFENCE OF SLBS"** APR 2023

"Sovereign SLBs could help incentivise climate policies in EU countries and accelerate emission reductions."

**BRUEGEL** MAR 2023

# 02

# BASIC PRICING OF SLBS

# 02 BASIC PRICING OF SLBS

## SECTIONS



## CASE STUDIES

# "The embedded optionality in an SLB is key to understanding its potential as a transition impact tool."

## 2.1 THE OPTION PRICING APPROACH: CONCEPT

Perhaps surprisingly for a new kind of financial instrument, there has been little effort to construct a theoretical framework that defines an SLB's 'fair value.' While empirical studies have produced a range of findings, these have generally not quantified the most basic feature of the SLB: the optionality of a coupon step-up or step-down.[1]

Without this understanding, the SLB market has given rise to many non-priceable instruments – a development that may hinder its long-term growth.

Schematically, the structure of an SLB implies how it should be priced. As we shall see, it also provides insight into the potential sustainability impact of the instrument, and shines a light on the incentives for the issuer.

A typical SLB has two components: a fixed-coupon bond and a coupon step option that confers on the investor a claim on a different fixed-rate cash flow if the issuer exceeds, or falls short of, its SPTs. This latter component can be referred to as an SLB embedded option.

The ensuing discussion on pricing concerns SLBs with step-up structures, unless specified otherwise. An investor in a step-up SLB is long the embedded option on higher cash flows in the event that the predetermined SPTs are not met: she is a "buyer" of the option. The issuer is short this same option: she is a "seller" or a "writer" of the option.

In this discussion, we will also assume a "risk neutral, no-arbitrage" condition to determine at what level the SLB coupon should be struck. It is important to understand this expression and why it forms the basis of our basic pricing approach:

**"Risk-neutral"**: This assumes that investors/issuers are indifferent to the SLB structure adding volatility to their investment returns/cost of capital. Even a risk averse investor can be assumed to be risk neutral, if this volatility is acceptable to investors in exchange for the non-pecuniary benefits produced by the instrument. From the issuer's perspective, the volatility and additional costs – like those related to acquiring a second party opinion on the bond – are warranted because of an SLB's direct and indirect effects on non-financial factors, such as reduced carbon emissions and market perception.

**"No-arbitrage"**: This assumes that investors/issuers are always able to select an equivalent vanilla bond (EVB), with coupon *C*, instead of an SLB. An EVB will be chosen over an SLB if the latter does not match or exceed the expected return of the former. Neither investor nor issuer will agree to something that would generate expected negative alpha for them.

[1] This section is mainly based on "Notes on Risk-Neutral Pricing of SLBs and Step-down Structures", AFII, 25 Oct 2022, and "Sustainability-Linked Bonds: An Option Pricing Approach", AFII, Aug 2022.

### 2.1.1 SLB VALUATION IN CHARTS

We illustrate the basic pricing approach in Figure 2.1. The left-hand graph shows the various pathways the SLB coupon can take compared to the coupon level of an EVB (with the coupon level illustrated by the dotted blue line).

For simplicity, we will assume there is a 50% probability that the issuer does not meet the SPTs and thereby triggers a coupon step-up. Using this as an input, we can calculate the expected coupon of the SLB over time, as shown in the right-hand panel of Figure 2.1 by the dashed orange line.

The first question is: why do we show the SLB fixed-rate coupon as lower than the EVB coupon until the step-up date?

The language of option pricing is useful here. Put simply, the investor is paying a premium to "buy" the embedded option in the SLB. This means the investor buys the bond at a higher price/lower yield/lower initial coupon compared to the EVB. The situation is reversed for the issuer. This premium is reflected as the size of the rectangle (A) in Figure 2.1.

In return for paying this premium, the investor receives the economic value of the option, measured as the expected coupon step-up after the step-up date. This is illustrated by rectangle (B) in Figure 2.1. Note the similarity of the embedded option payoff structure to that of a digital call option.

Armed with our risk-neutral, no-arbitrage condition, we can state that the areas of rectangles (A) and (B) should be similar. In other words, the investor's long option position is an asset that is commensurate in value to the issuer's short option liability.

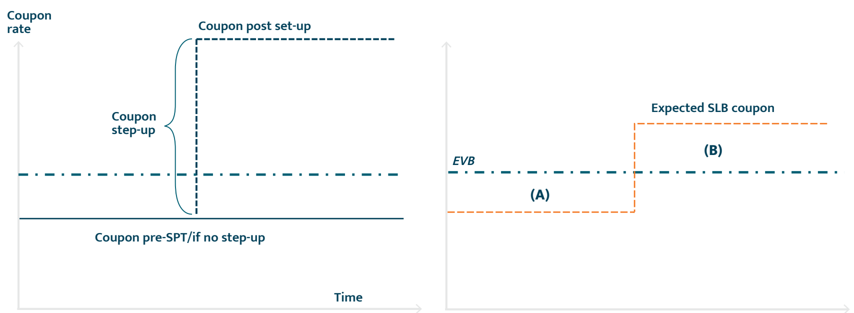
Translating this into bond language:

- **The SLB investor gets a lower initial coupon than an EVB but a higher expected coupon in the future.**
- **The SLB issuer gets an initial lower cost-of-capital, but only retains this lower cost-of-capital if they achieve their sustainability targets.**

What should happen to the fixed coupon of the SLB if we change the value of the option, for example, by shortening the period over which the coupon step-ups are paid out?

This is illustrated in the left-hand panel of Figure 2.2, where the initial option value goes from (B) to (B*). In order for our no-arbitrage condition to hold, the size of the rectangle (A) needs to decrease to (A*). This translates to a

**Figure 2.1** Embedded options structure of a step-up SLB: (left) the coupon level in the step or no-step up case, (right) the expected SLB coupon/the probability weighted average of the step and no-step up coupon levels.

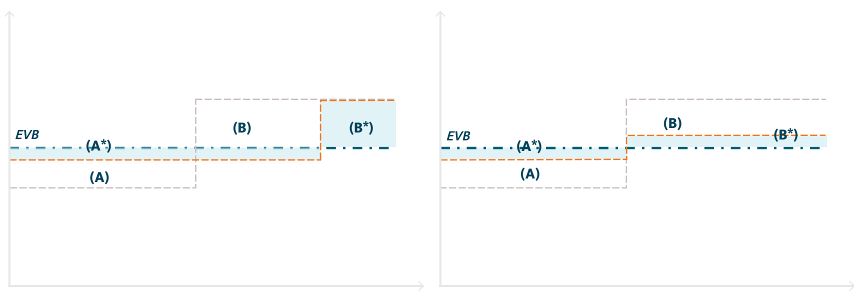


higher SLB fixed coupon in the period prior to the step-up, much closer to the EVB coupon.

**Similarly, how should the SLB fixed coupon change if we adjust the size of the step-up, e.g. from 25bps to 12.5bps?**

Figure 2.2, right-hand panel, shows this case. The reduced coupon step-up causes the area (B*) to be smaller relative to (B), and the no arbitrage condition simultaneously reduces (A) to (A*). This results in a lower differential between the EVB coupon and the SLB fixed coupon.

**Figure 2.2** (left) An SLB with a late step-up date: as the economic value accruing to the investor, (B) along the x-axis decreases, the option premium must also decrease, (A) => (A*), and the SLB fixed coupon moves closer to the EVB coupon. (right) An SLB with a lower coupon step-up than the baseline, B decreases along the y-axis to B*, lowering the option premium from (A) to (A*)




## WHY THE "OPTION PREMIUM" APPROACH MATTERS TO INVESTORS WITH FIDUCIARY DUTIES

Fiduciaries have a duty to maximise financial returns and minimise losses for their clients. This limits how much such investors can "pay" for non-pecuniary factors associated with selected investments, such as the sustainability commitments of the issuing entities.

This means that fiduciary duty may conflict with investments in green bonds, as these instruments are *pari passu* (equal in event of default) with EVBs of the same seniority in the issuing entity's capital structure. If a green bond prices tighter (ie, yields less) than an EVB, duty dictates that a fiduciary invest in the EVB rather than the green bond. Put another way, a fiduciary is not justified in paying a "greenium" if the purchased instrument has a risk/return profile indistinguishable from that of an EVB.[3]

In contrast, a fiduciary is justified in paying more for an SLB relative to an EVB because the SLB includes a valuable option that the EVB lacks. As a result, a fiduciary may invest in an SLB at a lower initial yield than for an EVB without breaching its duty if the optionality is sufficiently valuable. Note that this justification does not depend in any way on non-pecuniary sustainability factors, but rather on the claim to a higher probability-weighted cash flow.

[3] Fiduciary duty may still be fulfilled in the case of a greenium, if volatility is commensurately lower such that the risk/return ratio is constant, see "Green Bond Risk Premiums: A Twin-Bond ULFP Approach", Erlandsson, U., Jul (2020).

### 2.1.2 A SIMPLE MODEL FOR SLB VALUATION

We will now define the option premium mathematically. We first consider the premium paid from start of the life of the bond *(t=0)* to the period before it steps up *(t-1)*, and write this as:

$$(\mathrm{A}) = \sum_{i=0}^{t-1} \Phi_i \cdot (C^{EVB} - C^{SLB})$$

where $\Phi_i$ is the discount factor for time *i* (which runs from *0...t...T* where *t* is the step date and *T* is the maturity date), and where $C^{EVB}$ and $C^{SLB}$ is the EVB coupon and the SLB fixed coupon *i*. This is our **(A)** in the Figures 2.1-2.2

Next, we define the "value" of the option to the investor, the **(B)** in the Figures 2.1 and 2.2:

$$(\mathrm{B}) = \pi_1 \cdot \sum_{i=t}^{T} \Phi_i \cdot (C^{SLB*} - C^{EVB}) - \pi_2 \cdot \sum_{i=t}^{T} \Phi_i \cdot (C^{EVB} - C^{SLB})$$

where the probability to step is simply 1 – the probability to not step, i.e. $\pi_2 = 1 - \pi_1$.

In the above examples, we assumed the special case of a step probability of 50%, which symmetrically means a probability to not step of 50%.

As we have shown in the graphs, the simple condition that we need to hold is:

$(\mathrm{A}) = (\mathrm{B})$

So what inputs does the investor/issuer/analyst have to acquire to populate all the greeks in equations (A) and (B)?

- $\Phi_i$ – the discount factors – these are straightforward to calculate from interest rate data.
- *t*, the step-up date, as well as *T*, the final maturity, are specified in the SLB structure.
- $C^{EVB}$ – the coupon on an equivalent vanilla bond is found by generating a curve on the issuer's current bonds.
- the coupon step-up, $C^{SLB*} - C^{SLB}$, is also described in the SLB structure.

This leaves two variables, $C^{SLB}$, the SLB fixed-rate coupon, and $\pi_1$, the probability that a coupon step-up occurs. If we "know" $\pi_1$, then it is easy to solve for what $C^{SLB}$ should be under a no-arbitrage condition. Similarly, if we have $C^{SLB}$, then we can calculate an implied step probability.

# CASE STUDY 6
## GREENIUM VS SLB OPTION PREMIUM IN PRIMARY MARKETS

### RESEARCH: AN OPTION PRICING APPROACH FOR SUSTAINABILITY-LINKED BONDS, AUG 2022

"Greeniums" are the values that investors ascribe to a bond due to its positive impact potential, rather than the fair value of its probability-weighted cash flows.

This is a non-pecuniary factor linked to perception of the sustainability ambition of the issuing entity. "Greeniums" are typically associated with green bonds, which often contractually restrict the issuer's use of proceeds to explicitly environmentally friendly activities.

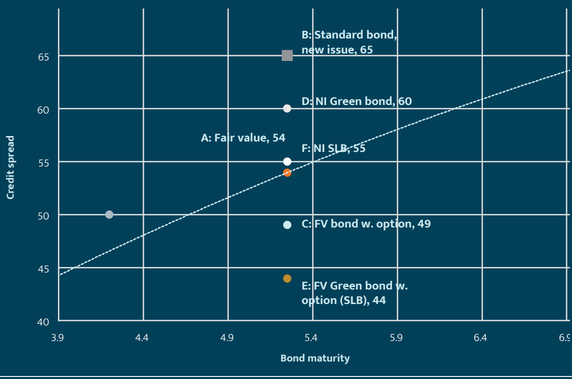
SLBs could also exhibit "greeniums", but these should be separated from the option premiums they attract, which are payments for optionality. While the sustainability ambition of an SLB issuer is expressed through the predefined SPTs rather than a predefined use of proceeds, this should not impact the primary market's perception of the ambition itself.

We illustrate this in Case figure 6.1 where we also add a new issue premium (NIP) component. In the example, we assume that a secondary market bond would trade at point A ("Fair value") at a spread of 54bps. However, a new issue bond would have to offer a new issue premium (NIP) of 11bps, landing it at 65bps (point B). Hypothetically, a new issue green bond would be issued at 60bps (point D), meaning that the real greenium in a green bond would be (B-A)-(D-A) = (65-54) - (60-54) = 5bps, when accounting for the inherent new issue premium.[4]

Now, if we assume that the optionality component in a coupon step-up bond would be worth 5bps to the investor, we would get a standard bond pricing with step-up optionality of 49bps (C), excluding NIP. If we define an SLB as a green bond with a coupon step-up, that SLB would then price with both the greenium (5bps) and the option premium (5bps) at 44bps (E) in fair value terms. However, given that it is a new issue, we need to add the NIP:

SLB new issue spread = Bond fair value + new issue premium – optionality value – greenium = F= A + (B-A) – (A-C) – (B-D) ⇔ F= B-A-C-D ⇔ D=B-A-C-F which is the expression to get the greenium in the SLB, accounting for NIP and embedded optionality.

We note that the NIP (B-A) can be inferred from cross-sectional analysis of the market.[5]




**Case figure 6.1**
Decomposing the 'greenium' and option premium in an SLB

[4] There are more factors to add here, such as a liquidity premium, but we believe that to some extent should be factored into the model that provides the fair-value spread.

[5] New issue premia across the market can be found through analysis of similar bonds being issued in a similar time-period and with similar bond features.

## 2.2 THE OPTION PRICING APPROACH: WORKED EXAMPLES

To better understand the option pricing approach discussed above, consider the following worked examples. These operate under a risk-neutral, no-arbitrage assumption, where the discounted probability-weighted cash flows of the SLB should equate to those of an EVB.

In the first example, assume a simple SLB structure, where the observation date of the SPT is at the end of year 4 *(t-1)* and the coupon step ($C^{SLB*}$ – note that we do not assume a step-up or step-down a priori) happens in year 5 *(t)*. The structure has a 10-year maturity *(T)*.

Furthermore, we assume a fixed discount rate *(r)* of 2% per annum. Coupons are paid on an annual basis. We assume that the cash flows represented by $C^{SLB}$ and $C^{SLB*}$ are risk-free, but will alter that assumption later on.

Most importantly, we assume a fixed and bilaterally known step probability ($\pi_1$) of 25%. $\pi_1$ represents the probability that the start-date coupon/spread $C^{SLB}$ will be adjusted to $C^{SLB*}$, meaning that $C^{SLB*} - C^{SLB}$ is the effective coupon step-up.

Now, consider the price of an EVB denoted $P_{EVB*}$. This will simply be the sum of discounted coupons until maturity:

$$P_{\text{EVB}} = \sum_{i=1}^{T} \frac{C^{EVB}}{(1+r)^i} + \frac{100}{(1+r)^T}$$

If we assume a coupon $C^{EVB}$ of 3.5% and a flat discount curve *(r)* of 2%, we can price the EVB to arrive at a price of 113.474 (see Table 2.1).

**Table 2.1** Pricing an equivalent vanilla bond (EVB), with a spread of 150bps

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EVB | 1.471 | 1.442 | 1.413 | 1.386 | 1.359 | 1.332 | 1.306 | 1.280 | 1.255 | 1.231 | **113.474** |
| NOMINAL | | | | | | | | | | 82.035 | |

Now let's turn to the SLB. We assume a step-up of 50bps based on the discounted cash flows and the fixed probability that the step will happen. The price of such a structure paying a fixed coupon $C^{SLB}$ can be written as:

$$P_{\text{SLB}} = \sum_{\text{i}=1}^{\text{t}} \frac{C^{SLB}}{(1+\text{r})^{\text{t}}} + \pi_2 \cdot \sum_{i=t+1}^{T} \frac{C^{SLB}}{(1+r)^i} + \pi_1 \cdot \sum_{i=t+1}^{T} \frac{C^{SLB*}}{(1+r)^i} + \frac{100}{(1+r)^T}$$

The results of repricing this same structure with $\pi_1$ = 25% are illustrated in Table 2.2. Note that the pre-step-up (1...*t*) cash flows are identical in value to the EVB that we saw in Table 2.1. Further note that from (*t*+1), assuming no step-up takes place, the cash flows are also equivalent to those of the EVB. However, the cash flows bifurcate in the step-up case, as they are more valuable (see the third row in Table 2.2).

As there is a 25% probability of that 116.061 price materializing (ie, the step-up occurs), and a 75% probability of the 113.474 price enduring (ie, the step-up does not occur), simple arithmetic implies a weighted value for the SLB of 114.121 (as shown in the bottom row of Table 2.2).

Clearly, when we price the SLB, it has a higher economic value for the investor/price than the EVB. In the option pricing language, we could say that the option premium is/should be the difference in price, i.e. 114.121 – 113.474 = 0.647.

**Put simply, an investor would be willing to pay up to 0.647 for switching from the EVB to the SLB structure. On the flip side, there is no reason the issuer would issue an SLB unless they would actually be paid the optionality, worth 0.647.**

**Table 2.2** Step-up SLB 150bps fixed spread, 50bps step-up, 25% probability to step, risk-free discounting

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-STEP, 0...T | 1.471 | 1.442 | 1.413 | 1.386 | | | | | | | |
| NO STEP, *T+1...T* | | | | | 1.359 | 1.332 | 1.306 | 1.280 | 1.255 | 1.231 | 113.474 |
| STEP, *T+1...T* | | | | | 1.811 | 1.776 | 1.741 | 1.707 | 1.674 | 1.641 | 116.061 |
| WEIGHTED VALUE | 1.471 | 1.442 | 1.413 | 1.386 | 1.472 | 1.443 | 1.415 | 1.387 | 1.360 | 1.333 | **114.121** |

Therefore, assuming the 150bps fixed spread and 50bps step-up under risk-neutral, no-arbitrage conditions, the SLB trade would not happen.[6]

At what coupon level would this trade be acceptable to both investor and issuer? Let's keep the coupon step level (50bps) constant and calculate how this bond prices with a lower fixed spread.

In Table 2.3, we reprice the bond with a 135bps fixed spread. The bond prices lower, at 112.773, meaning that the investor would not buy this structure unless compensated by a lower price compared to the EVB.

**Table 2.3** Step-up SLB 135bps fixed spread, 50bps step-up, 25% probability to step, risk-free discounting

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-STEP, 0...T | 1.324 | 1.298 | 1.272 | 1.247 | | | | | | | |
| NO STEP, *T+1...T* | | | | | 1.223 | 1.199 | 1.175 | 1.152 | 1.13 | 1.1075 | 112.126 |
| STEP, *T+1...T* | | | | | 1.676 | 1.643 | 1.611 | 1.579 | 1.548 | 1.518 | 114.714 |
| WEIGHTED VALUE | 1.324 | 1.298 | 1.272 | 1.247 | 1.336 | 1.310 | 1.284 | 1.259 | 1.234 | 1.210 | **112.773** |

As risk-neutral investors require the value of the SLB and the EVB to be identical to justify investment in the former, we can express a condition that:

$$P_{SLB} = P_{EVB}$$

In other words, there should be no price differential, meaning that the investor as well as the issuer would be indifferent to either the EVB or SLB:

$$P_{SLB} - P_{EVB} = 0$$

[6] In this, we assume for simplicity that all bonds price at par. Non-par bonds would need to achieve the same conditions but in yield/spread terms instead.

This simple relationship means we can goal-seek variables, such as the initial coupon on the SLB, to reverse-engineer an SLB price that is equivalent to the price of the EVB.

In Table 2.4, we show that if the SLB fixed coupon is set at 142.8bps, then the probability-weighted present value of the SLB cashflows are equivalent to those of an EVB with a fixed coupon set at 150bps $\Leftrightarrow P_{SLB} = P_{EVB}$.

In option terminology, the investor would be willing to pay a 150bps - 142.8bps = 7.2bps "option premium" to enter into the SLB with a step-up structure.

**Table 2.4** Step-up SLB 142.8bps fixed spread, 50bps step-up, 25% probability to step, risk-free discounting

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-STEP, 0…T | 1.400 | 1.373 | 1.346 | 1.319 | | | | | | | |
| NO STEP, *T+1…T* | | | | | 1.293 | 1.268 | 1.243 | 1.219 | 1.195 | 1.1714 | 112.827 |
| STEP, *T+1…T* | | | | | 1.746 | 1.712 | 1.678 | 1.646 | 1.613 | 1.582 | 115.414 |
| WEIGHTED VALUE | 1.400 | 1.373 | 1.346 | 1.319 | 1.407 | 1.379 | 1.352 | 1.325 | 1.299 | 1.274 | **113.474** |

For a second example, let's assume an SLB with a step-down structure, instead of a step-up structure. Step-down structures positively incentivise issuers to achieve their SPTs in order to gain the "reward" of lower coupon payments. SLBs with step-down structures are also more aligned with products sold as sustainability-linked loans (SLL), which typically do not use step-ups.

Under the framework described above, the pricing of a step-down SLB is symmetric to that of a step-up SLB. Assuming the SLB has a 50bps step-down and the same fixed-coupon as in the first example, an investor should require the fair value of the SLB to be 7.2bps higher than that of the EVB to compensate them for the probability of receiving a lower SLB coupon if the step-down is triggered.

**Table 2.5** Step-down SLB with 157.2bps fixed spread, 50bps step-up, 25% probability to step, risk-free discounting

| YEAR | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-STEP, 0…T | 1.541 | 1.511 | 1.481 | 1.452 | | | | | | | |
| *NO STEP, T+1…T* | | | | | 1.424 | 1.396 | 1.369 | 1.342 | 1.315 | 1.2896 | 114.121 |
| *STEP, T+1…T* | | | | | 0.971 | 0.952 | 0.933 | 0.915 | 0.897 | 0.879 | 111.533 |
| WEIGHTED VALUE | 1.541 | 1.511 | 1.481 | 1.452 | 1.311 | 1.285 | 1.260 | 1.235 | 1.211 | 1.187 | **113.474** |

Therefore an entity should typically expect to pay an initial fixed-rate coupon in excess of that of an EVB when issuing a step-down SLB. The logic is simple: investors need to be compensated by a higher coupon today for an expected lower coupon in the future.

Using this pricing framework, we can also reverse-engineer SLB structures to fit certain funding needs. For example, we can ask questions like: "If the issuer is seeking a 5bps reduction in cost-of-capital versus an EVB by issuing an SLB, how should they set the coupon?"

These questions are likely to be asked by corporate treasurers who are incentivised to optimise their entity's financing costs. Put simply, there might be a bonus in it for a treasurer that manages an issuance program X basis points inside some target benchmark curve plus new issue premiums.

## 2.3 PRICING: THE EMPIRICAL EVIDENCE

Central to the attraction of SLBs as complements to fixed income portfolios is that their key features – their embedded options – are financial rather than non-pecuniary.

To the market, the pricing differential attributable to non-pecuniary features is generally called a "greenium", most clearly observable in the issuance of identical German government securities, as illustrated in Figure 2.3. Two identical bonds, but one with a green UoP, trade with a spread differential – a greenium – that represents the amount of return that some investors are willing to forgo in order to support that UoP.

However, the greenium phenomenon, as we shall explain, is not the key to the pricing differential between an SLB and an EVB.

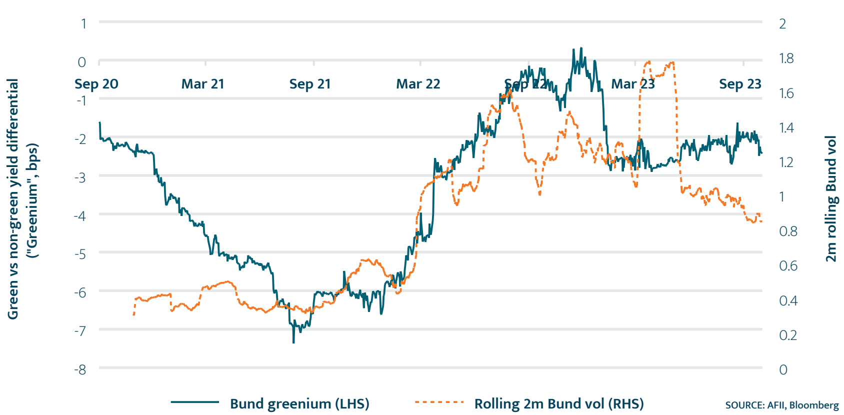
Consider the German green bund in the example. What would happen if the same bond promised a higher coupon three years from now (2027), until the maturity of the bond (2030), if Germany were to fall short of her net-zero aligned carbon reduction targets by that observation date?

That would, of course, make this iteration of the bund more valuable to the investor than the EVB from a financial standpoint. Non-pecuniary features would be irrelevant in this context. If an investor believes there is a 50% probability that a political coalition will come to power in Germany that will deviate from this net-zero target by slowing the rate of emissions reduction, then that investor should also assume a 50% probability that the 2027-2030 higher coupon rates will apply.

If we further assume that there will be a 0.25% coupon step-up for the four years 2027-2030, total coupon step-ups will come to EUR1 per EUR100 invested. If we calculate the net present value of that EUR1 to be 75 cents, and the investor believes there is a 50% probability of that being paid out, then they would be willing to have a 50% x 75c x (1/7) ~= 0.053% lower coupon in the three years prior to the step-up date relative to a version of the bund without step-up potential.

Significantly, that 5bps lower yield is financially justified. It has nothing to do with the bund's non-pecuniary features, and should therefore, in our opinion, be separated from a non-pecuniary greenium. This also means that you do not need to be an "ESG" or "green" investor to justify allocating to such an instrument. You are simply paying for the potential upside of the coupon step-up with a lower initial rate, like placing a wager.

**Figure 2.3** German Bund greenium (blue, LHS) for the twin 10yr bonds, and 2-month Bund volatility (orange, RHS)




SOURCE: AFII, Bloomberg

### 2.3.1 SLB PRICING VERSUS THE CURVE

It is not always straightforward to disentangle a non-pecuniary greenium from the embedded option premium in an SLB structure. Making things harder, the literature often conflates the two sources of pricing differential. It also disagrees on how best to measure greeniums, since their analysis is by nature subjective.

An example of how different premiums manifest in the primary market is provided in Case study 6 (page 37).

Even if we assume the new issue premium of a bond is zero, as is the case with mature bonds in the secondary market, there remain difficulties determing what accounts for the difference in spread between an SLB and any 'fair value.' As we explain above, structural features are important. But so are technical dimensions of market demand.[7]

Curve fitting is one approach to disentangling premiums. An example of this approach is shown in Figure 2.5 for the Abertis EUR4.125 08/2029 SLB and its accompanying fair value projections created using various fitting models, each with advantages and drawbacks.

A linear model is extremely simple to use, but cannot express any curvature. A log model can capture some curvature but is not able to invert. A quadratic model needs at least three bonds to be fitted. A cubic model has even greater flexibility but tends to overfit.

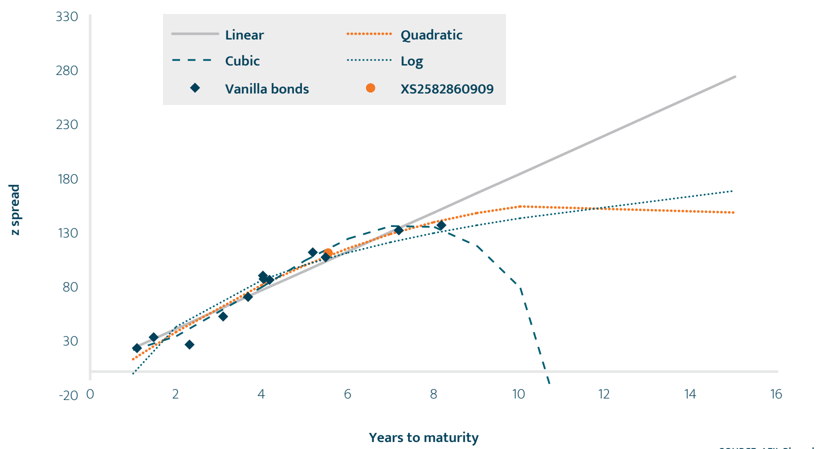
If we look at our particular example, the range of estimates based on the interpolation method goes from -4.67 to +6.87, see Table 2.6. This goes to show that the estimates of greeniums vary quite a lot, even in terms of their signs – plus or minus – and using rather parsimonious and individually reasonable curve fitting models.

**Table 2.6** Curve model estimates of spread premium for Abertis EUR4.125 08/2029 SLB. Source: AFII, Bloomberg

| | FORECASTED VALUES | | | |
|---|---|---|---|---|
| SLB Z-SPREAD | LINEAR | QUADRATIC | CUBIC | LOG |
| 109.67 | 102.80 | 106.78 | 114.33 | 104.88 |
| PREMIUM | 6.87 | 2.88 | -4.67 | 4.78 |

Note that this happens in a case with 11 bonds in a 7-year maturity window, which must be considered a relatively large dataset in the context of SLB analysis.

**Figure 2.5** Spread curves fitted to vanilla bonds (blue) and non-fitted SLB bond spread (red)




SOURCE: AFII, Bloomberg

[7] For an overview of structural features, see "Green bond risk premiums", Erlandsson U, 2020.

To conduct a sensible cross-section analysis of an SLB's pricing versus the curve, we first want to ensure that we are only working with bonds with realistically observed market prices. For our analysis, we only consider bonds trading in benchmark size (USD250mn or more) in EUR and USD, and issuers with more than USD1bn equivalent in debt outstanding. This leaves a sample of 72 issuers that have issued SLBs in EUR. From these issuers, we select all benchmark bonds in the same currency, with at least 1 year left until maturity, and only those issuers with at least 2 bonds on the curve. We also discard curves where the SLB is more than 1 year outside the longest bond.

Finally, rather than trying to find an optimal 'model', we instead iterate between all issuer curves and select between a 1-3 degree polynomial or a logarithmic curve, or simply decide a curve is not admissible, based on practical experience. This leaves 26 SLBs and issuers, described in Table 2.7.

In this curated sample, the average and median spread premiums sit at around 1.8bps (the SLB spread being tighter than that of the vanilla bond), which seems to imply that some of the embedded option value is being priced in. However, the standard error around this is high (11bps) such that the results bear little statistical significance.

**Table 2.7** Estimated spread premiums for EUR liquid curves of SLB issuers. Source: AFII, Bloomberg

| TICKER | SLB ISIN | YRS TO M. | Z-SPREAD | CURVE FIT | FORECAST | PREMIUM |
|---|---|---|---|---|---|---|
| JABHOL | DE000A3K5HW7 | 8.4 | 137.0 | LOG | 118.7 | 18.3 |
| ORFP | FR0014009EJ8 | 2.4 | 15.3 | LOG | 15.1 | 0.2 |
| SANFP | FR0014009KQ0 | 5.2 | 26.4 | QUAD | 19.0 | 7.4 |
| RCFFP | FR001400ASK0 | 5.4 | 116.6 | LOG | 146.4 | -29.8 |
| RIFP | FR001400DOV0 | 4.8 | 48.4 | LOG | 50.3 | -2.0 |
| LRFP | FR001400I5S6 | 5.3 | 50.6 | LOG | 36.8 | 13.9 |
| ORAFP | FR001400KKM2 | 11.6 | 78.2 | QUAD | 72.5 | 5.7 |
| ENIIM | IT0005521171 | 4.0 | 68.6 | QUAD | 59.1 | 9.5 |
| NOVNVX | XS2235996217 | 4.7 | 25.8 | LOG | 6.0 | 19.8 |
| HOLNSW | XS2261215011 | 7.2 | 112.3 | LOG | 115.6 | -3.3 |
| TSCOLN | XS2289877941 | 5.5 | 93.4 | LOG | 103.1 | -9.7 |
| REPSM | XS2361358299 | 5.4 | 68.5 | LOG | 62.3 | 6.1 |
| TEVA | XS2406607171 | 6.3 | 299.7 | LOG | 281.2 | 18.4 |
| KPN | XS2406890066 | 9.8 | 90.2 | LOG | 94.5 | -4.3 |
| SRGIM | XS2433211310 | 5.4 | 99.9 | LOG | 93.3 | 6.6 |
| IPGIM | XS2437324333 | 2.5 | 148.3 | LOG | 142.0 | 6.2 |
| AEMSPA | XS2457496359 | 4.1 | 72.5 | QUAD | 70.8 | 1.8 |
| NEGANV | XS2498042584 | 10.5 | 66.2 | LOG | 73.7 | -7.5 |
| SGOFP | XS2517103334 | 8.5 | 72.0 | LOG | 85.2 | -13.2 |
| EOFP | XS2553825949 | 2.4 | 116.8 | LOG | 117.2 | -0.3 |
| ABESM | XS2582860909 | 5.5 | 109.7 | QUAD | 106.8 | 2.9 |
| HTHROW | XS2648080229 | 9.5 | 122.5 | LOG | 121.7 | 0.9 |
| ENELIM | XS2751666426 | 4.5 | 75.1 | LOG | 81.7 | -6.6 |
| **AVERAGE** | | **6.05** | **91.91** | | **90.13** | **1.78** |
| **MEDIAN** | | **5.42** | **78.24** | | **85.19** | **1.76** |

[8] We dismiss curves that appear non-sensible and unlikely to be used for any practical portfolio purposes. Admittedly, this is a subjective approach, but with the counterargument that any approach to deciding on a curve model for bonds is ultimately a subjective exercise either way.

An alternative approach is to use fair-value estimations based on bonds that are close neighbours to the SLBs:[9] for example, if our Abertis SLB has a 5.3yr maturity, what are the bonds close to that maturity on the Abertis curve?

Using those we can make a (linear) interpolation of the spreads of those bonds to infer what the SLB spread should be, if there were no optionality. This approach does however require a (subjective) choice of the window of admissible bonds: in Table 2.8 we show the different estimates for the SLB premium of the Abertis bond, based on various admissible windows. Again, there is a fair amount of variation, from -0.89bps to 5.89bps of premium.

The academic literature on SLB pricing sometimes comes to surprisingly firm conclusions on the existence of the premium. For the practitioner, a first indicator of the relevance of such studies should be the sample size: if the number of SLBs in the study is sizable, one needs to consider if the data is based on actually traded, liquid SLBs, with reasonably comparable vanilla bond curves. Perhaps more importantly, there needs to be the distinction between optionality premium (which is rational) and non-pecuniary greenium.

As it stands, it seems that the SLB asset class is still too small and complex to provide a firm answer on the greenium and/or option premium question, especially as option premiums have historically been small by design. As we suggest at the end of this chapter, more sizable premiums would make the analysis more straightforward.

**Table 2.8** Window-estimates of spread premium for Abertis EUR4.125 08/2029 SLB. Source: AFII, Bloomberg

| WINDOW | FORECASTED SPREAD | PREMIUM |
|---|---|---|
| CLOSEST NEIGHBOURS | 104.89 | 4.77 |
| 1.5YRS | 110.56 | -0.89 |
| 2YRS | 107.68 | 1.99 |
| 3YRS | 103.78 | 5.89 |

## 2.4 PROBABILITIES: CENTRAL TO SLB PRICING

The fixed coupon of an SLB ($C^{SLB}$) is deterministic. This means it can be agreed between the investor and issuer. In contrast, the step probability ($\pi_1$) is stochastic and will vary over time. The step probability is also likely to be contested among investors, with each having a different view on how likely it is that the issuer will achieve its SPTs.

However, there are some rough principles an investor can apply when estimating step probability.

First, the step probability is tied to how hard it is for the issuer to achieve their selected SPTs. Put another way, it is a measure of the issuer's sustainability ambition. If ambition is defined as how hard it is to achieve a target, a high ambition level will mean that the probability that the SPT will not be achieved is high.

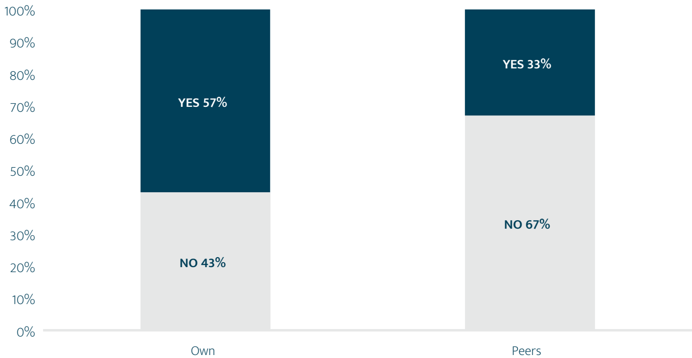
This is logical. After all, it is harder to win the 100m gold medal at the Olympics (high ambition/high probability of step-up) than it is to beat the third snooze on your alarm clock by getting out of bed (low ambition/low probability of step-up).

Olympic participants will often overestimate the likelihood that they will win the competition relative to outsiders that are more neutral on their chances. An analogy to this can be found in a 2023 Bloomberg Intelligence survey of 250 CEOs. The survey indicates that most companies (63%) believe they will achieve their net-zero targets, while a minority (37%) believe their sector peers will do so (see Figure 2.4).

The fact that investors assign different step probabilities to the same SLB is an important driver of transactions. Consider the survey example above: theoretically, a company that has an above-market expectation that they will hit net-zero targets should be issuing SLBs and investing in the SLBs of peers they believe have an underpriced probability of missing their targets. This way, they will pay less for their

[9] An oft cited example of this can be found in "Who pays for sustainability? An analysis of Sustainability-Linked Bonds", Kölbel, J, and Lambillon, A-P., Swiss Finance Institute Research Paper No. 23-07, 12 Jan 2022.

**Figure 2.4** "Will you/your peers hit their net-zero targets?" Illustrating diversity of estimated probabilities: corporates believe they will themselves hit net-zero targets, but that their peers will not. Source: Bloomberg Intelligence

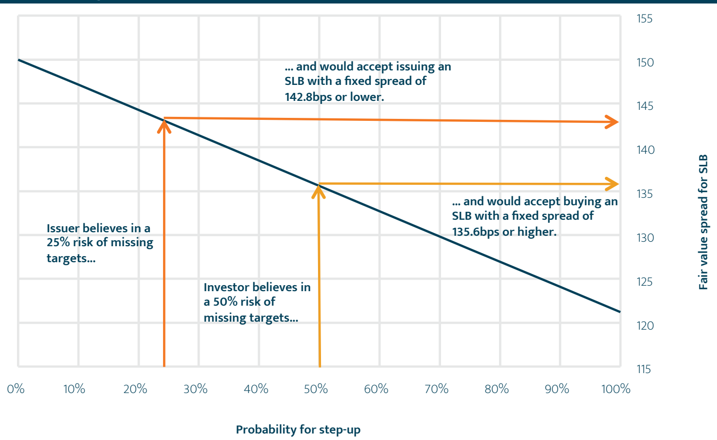



own debt capital while receiving the higher step-up coupons from the SLBs of their peers.

We illustrate how differences in opinion should drive SLB issuance, based on our previous calculations, in Figure 2.5. In this example, the issuer believes there is a 25% probability that they will miss their SPT, and thus would only sell the SLB at a spread of 142.8bps or lower. The investor, however, believes there is a higher probability, 50%, of the issuer missing the target, and thus would buy the SLB at a fixed spread of 135.6bps or higher. This means that in the 135.6bps to 142.8bps range, both sides would be willing to strike a deal.

Clearly, having some understanding of the probability of an SPT being achieved is an advantage when it comes to valuing the embedded option in an SLB. We elaborate further on this topic in Chapters 3, 4, and 5.

**Figure 2.5** Illustrating how different views on probabilities to hit/miss SPTs can drive SLB transactions



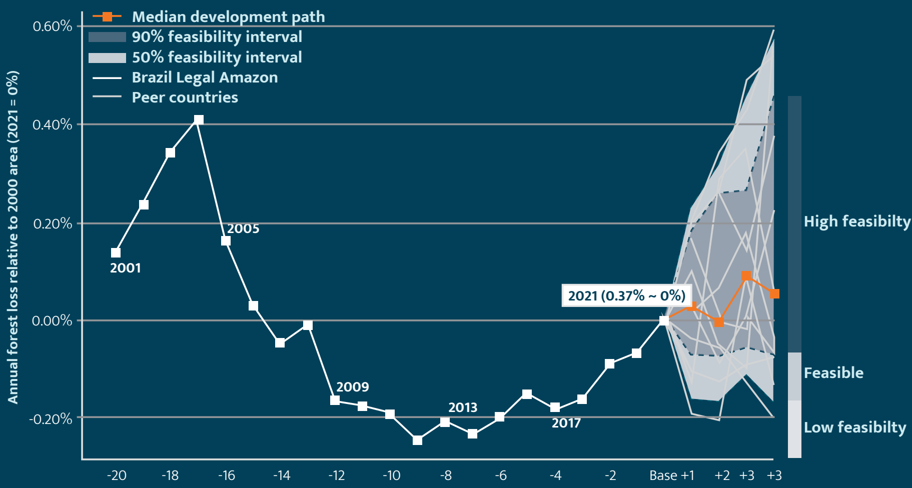
# CASE STUDY 7

## PROBABILITIES IN AN SLB CONTEXT: THE WORLD BANK FAB APPROACH

**RESEARCH: COULD SUSTAINABILITY-LINKED BONDS INCENTIVISE LOWER DEFORESTATION IN BRAZIL'S LEGAL AMAZON (WORLD BANK POLICY RESEARCH WORKING PAPER 10558), OCT 2023**

**The World Bank paper introduces a framework where SPTs are measured based on both ambition as well as feasibility, in what is called the Feasibility-Ambitiousness (FAB) matrix. Ambition is a forward-looking measure, whereas feasibiltiy uses backward-looking data.**

**A key conclusion of the paper is that extremes of either too high or too low FAB levels are undesirable, and that reachable targets are also most likely to be where SLB funding can offer the most additionality. For pricing purposes, this suggests that SLB structures should be constructed with probabilities nearer 50% rather than at the extremes at the low or high end.**




**Case figure 7.1** Feasibility analysis for deforestation reduction targets

The grey lines (to the right of the figure) are deforestation trajectories from selected tropical forest countries with similar forest loss levels as Brazil (Legal Amazon) in 2021. These historical precedents depict the range of what has been achieved within four years in the past.The orange line shows historical forest loss for Brazil's Legal Amazon between 2015 and 2021, standardised to 0 in 2021. Annual forest loss is expressed relative to the forest area in peers' base year and as the change from Brazil's Legal Amazon's most recent value:0.37%

| | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|
| **MOST RECENT VALUE** | 0.37% (13,235 km²) | | | | |
| **AMBITIOUSNESS** | | | | | |
| Average BAU scenario forecast | | 0.31% (11,178 km²) | 0.25% (8,738 km²) | 0.24% (8,469 km²) | 0.24% (8,470 km²) |
| Cutoff: low ambitiousness/ ambitious | | 0.30% (10,640 km²) | 0.25% (8,749 km²) | 0.24% (8,461 km²) | 0.24% (8,426 km²) |
| Cutoff: ambitious/highly ambitious | | 0.28% (9,802 km²) | 0.23% (8,122 km²) | 0.23% (8,016 km²) | 0.23% (8,083 km²) |
| **FEASIBILITY** | | | | | |
| Median development path | | 0.40% (14,235 km²) | 0.37% (13,108 km²) | 0.46% (16,464 km²) | 0.43% (15,169 km²) |
| Cutoff: feasible/highly feasible | | 0.30% (10,689 km²) | 0.30% (10,636 km²) | 0.31% (11,260 km²) | 0.30% (10,769 km²) |
| Cutoff: low feasibility/feasible | | 0.21% (7,549 km²) | 0.21% (7,392 km²) | 0.26% (9,361 km²) | 0.21% (7,321 km²) |

**Case table 7.2** Example of World Bank's FAB analysis, applied to forest loss rates in Brazil's legal Amazon. Source: World Bank

## CASE STUDY 8
## PRICING LOST OPTIONALITY: SEMBCORP

RESEARCH: SEMBCORP: CARBON FOOTPRINT ARBITRAGE OF A LIFETIME
BOND: SCISP SGD2.66% 04/32 (SGXF52048042), NOV 2022

Sembcorp Industries, an energy and urban development company headquartered in Singapore, issued in September 2021 an SLB (SCISP 2.660% 06Apr2032) with a 25bps step-up from end-2025 if a decarbonisation SPT is not achieved. Following the issuance, Sembcorp shifted the primary source of its carbon emissions off balance sheet by financing the sale of two coal-fired power plants to a private Omani consortium. This means the decarbonisation SPT will now be achieved with almost 100% certainty.

By evaluating the option value inherent in the SLB, we can assess the loss to investors, if this type of carbon accounting is affirmed for determining adherence to the SPT. If we assume that investors held a 50% step-up probability view, what has the offloading of Sembcorp's coal-fired power plants cost them?

Using assumptions around discount rates etc, we see the price differential between the SLB and the EVB – i.e. the loss to the investors from this manoeuvre – to be approximately 0.71 cents on the dollar.

| YEAR | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EVB | 0.00 | 2.57 | 2.50 | 2.43 | 2.36 | 2.29 | 2.22 | 2.15 | 2.09 | 2.02 | 1.96 | **96.40** |
| NOMINAL | | | | | | | | | | | 74.41 | |

**Case table 8.1** Pricing the Sembcorp SLB as a vanilla bond, risk-free discount rates

| YEAR | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 | 2031 | 2032 | BOND PRICE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRE-STEP, 0…t | | 2.57 | 2.50 | 2.43 | | | | | | | | |
| NO STEP, *t+1…T* | | | | | 2.36 | 2.29 | 2.22 | 2.15 | 2.09 | 2.02 | 1.96 | 96.40 |
| STEP, *t+1…T* | | | | | 2.58 | 2.50 | 2.43 | 2.36 | 2.28 | 2.22 | 2.15 | 97.82 |
| WEIGHTED VALUE | | 2.57 | 2.50 | 2.43 | 2.47 | 2.40 | 2.33 | 2.26 | 2.19 | 2.12 | 2.06 | 97.11 |

**Case table 8.2** Pricing the Sembcorp SLB using a 50% probability to step, risk-free discount rates

*(This example is continued in the Advanced pricing section, where the bond price is calibrated to market observed pricing, using an implied default probability.)*

## 2.5 GREENBACK SLBS[10]

The option pricing framework provides a means to discuss the common objections to SLBs that focus on either lack of ambition or lack of financial materiality.[11] Referring back to Figure 2.2, both these objections are essentially arguing that area (B)=(A) is "too small".

But what is "too small" really? How long is a piece of string? In this section, we introduce a rule-of-thumb for sizing an SLB's optionality. Those instruments complying with the rule we call "greenback SLBs".

We introduce the following definitons:

**DEFINITION 1: A "greenback SLB"** *is a sustainability-linked bond where the expected pay-out of the step structure is at least one dollar (one percentage point) in absolute risk-discounted value, with an assumed 50% step probability.*

**DEFINITION 2: A "standardised greenback SLB"** *is where the coupon pay-out structure and maturity at primary issuance approximately align to the standard points on the CDS curve, ie, 3yr, 5yr, 7yr and 10yr points (and 3s5s, 5s7s, 5s10s curves).*

As described above, a low ambition SPT equates to a low step probability ($\pi_1$) as illustrated in Figure 2.8.[12] Even if the discounted value of the step-up is substantial, it is deflated in terms of expected value due to the low probability of it happening. The is a problem, as highlighted by the squiggly line, because it becomes very difficult to assign any option value to the step. In this situation, the issuer will have a hard time obtaining lower cost-of-capital, as the investor gets near zero upside.

In Figure 2.9 we illustrate the case where a pay-out is not financially material, even if the step probability is high, because the step-up is low or the step-up pay period is short. "Weak" SLBs are often characterised by short pay-out periods, of one or two years maximum. Again in this case the issuer faces difficulty attracting investor interest, because the upside value is limited.

Lack of ambition and lack of financial materiality can be fatal to SLB issuance. After all, why should issuers/investors put effort into the analysis of a bond that will provide neither a measurably lower cost-of-capital (if successfuly placed), nor a significant financial hedge (if sustainability conditions are not met)?[13] Geometrically speaking, in Figure 2.1 we need to see area (A) = area (B) increase to

**Figure 2.8** An SLB with a low financial value assigned to the step-up, making the expected step value and optionality small

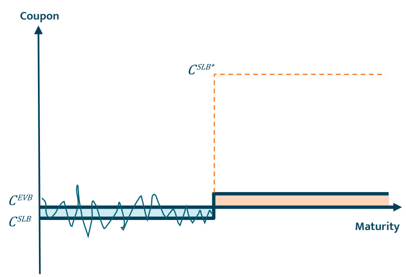
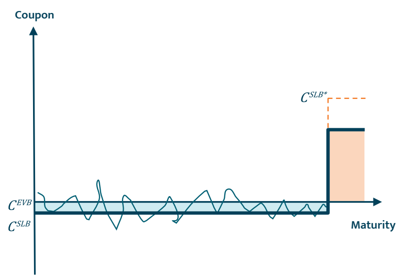



**Figure 2.9** An SLB with a low step probability, making the expected step value and optionality small




[10] "Greenback SLBs: an impact standardisation proposal", AFII, Oct 2022.

[11] See, for example, "SLBs Need to Address Credibility Issues to Resume Growth", ESGToday, 15 Feb 2023.

[12] An ambitious target will be harder to achieve and, thus, generate a higher probability of a step up.

such a size that they are considered adequate in terms of issuer compensation, as well as investor potential upside.

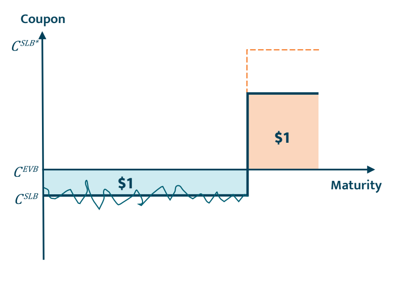
This is where the greenback SLB concept comes in. To be classified as such, the financial materiality of an SLB has to be worth at least one dollar (1% of nominal value) of the bond price, assuming a 50% step probability.[14] The geometrical equivalent is to declare a minimum size of 1 for areas (A) = (B) in Figure 2.2, and further illustrated in Figure 2.10. The combination of high enough step probability and high enough step financial value should be sufficient to force a pricing difference between the SLB fixed coupon and an EVB fixed coupon.

We need the following data and inputs to identify whether an SLB qualifies as a greenback:

- Step-up date *t* and maturity *T*. In the visuals of the Figures 2.1 and 2.2, this is how far the option premium rectangles stretch out across the x-axis.
- Discounting curve/method ($\Phi_i$). This should be relatively straightforward to decide on, and if using a risk-discounting approach (ie, using a discount curve from bonds with a similar rating to the SLB) the method has several benefits as discussed in "Advantages to a price approach" below.
- Probability of step ($\pi_1$.). We set a fixed step probability of 50%. This roughly aligns with how defaulted bond recovery values are assumed to be 40% in CDS pricing models. This percentage is, in our opinion, substantially above what is being implied in the market today, where targets are often considered to be easily achievable, and therefore given a low step probability. Providing a fixed step probability in this way is helpful for calculating other variables. It also provides a common starting point for discussions between investors and issuers. Once other SLB parameters are set, differences in opinion over the actual step probability will be key to valuation of the SLB, as discussed in the probabilities section above.

With these inputs, one can simply evaluate what coupon with step-up ($C^{SLB*}$) is required to achieve a USD1 optionality value in the SLB.[15] Furthermore, with this value one can also derive what the fixed coupon of the SLB should be ($C^{SLB}$). These numbers form the bottom rows of Table 2.9 and Table 2.10 (on the following pages).

**Figure 2.10** Greenback SLB: jointly, the value of the probability of step and the financial upside of the step-up is USD1




[13] We elaborate further on the use of SLBs as a financial hedge versus poor sustainability outcomes in Chapter 3.

[14] Bond pricing discussions are fraught with a mix of terminologies. Our "one dollar" definition comes from the literature often referring to bond pricing in terms of USD100 as the nominal, and the greenback then diverging by at least USD1 (1%) from the nominal.

[15] For computational simplicity, we assume that the option value is measured as the expected value of the step-up relative to an EVB.

### 2.5.1 GREENBACK OR NOT: SOME EXAMPLES

Below we perform several calculations on SLB structures[16] across the pay-out period (x-axis, also see section below) and step-up (y-axis).

Table 2.9 (below, left), denotes greenback status (option value >USD1) in blue highlight. This shows the baseline case for an SLB in EUR with a 4.5% coupon, an assumed 50% step probability, and discounted using a EUR BBB discount curve. The penultimate row indicates the coupon step-up required for reaching "greenback" status. For example, for an SLB with a 5yr observation date and 5yr pay-out period, the coupon step-up would need to exceed 51.8bps to achieve greenback status. The final row indicates what the SLB fixed coupon spread would be, relative to an EVB. In this case, assuming an EVB coupon of 4.5%, the SLB should price at 4.378bps, or almost 4 3/8s, with a step-up of 54bps.

Table 2.9 (below, right) shows the same bond but with (a higher) USD BBB discount curve, which means higher step-ups are required to achieve greenback status, but slightly lower fixed SLB coupons.

Table 2.10 (next page, left) shows a greenback for a EUR B-rated discount curve. Fixed coupons increase marginally, with step-ups increasing more to compensate for inherent default risk.

Table 2.10 (next page, right) restrikes the step probabilty to 100% which leads to a (linear) 50% drop in required coupons for greenback status.

The greenback SLB concept does not provide guidance on structuring the coupon step-up period: a short pay-out period could be matched by a large coupon step, or vice versa. It seems sensible to also look for a standardisation in terms of how far from the step-up date the final maturity should be.

Historically, the bulk of bond issuance has usually happened on the intermediate part of the curve, with the 3yr, 5yr, 7yr and 10yr maturities as 'standard' issuance points. Outside 10yr, 30yr issuance has been the dominant long-end issuance point. This is also reflected in how credit derivatives (CDS) trade,[17] with the 5yr being the main point, but with curves offered across the intermediate spectrum (3s5s, 5s7s, 5s10s).

These points of issuance could also be considered in the context of SLB step-ups and final maturities. Assume an SLB with an SPT in 5 years, with a potential step-up pay period of 2 years, for a full maturity of 7 years, and we have a structure that can be related to the derivatives market.

**Table 2.9** (left) Baseline EUR BBB discounting curve; (right) USD discount curve

| OPTION VALUE<br>Disc: EUR BBB | with 50% prob /4.5% fixed coupon<br>Step structure | | | | |
|---|---|---|---|---|---|
| **Coupon step** | **3s5s** | **5s7s** | **3s7s** | **7s10s** | **5s10s** |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.125 | 0.106 | 0.098 | 0.204 | 0.133 | 0.231 |
| 0.25 | 0.212 | 0.196 | 0.408 | 0.266 | 0.462 |
| 0.375 | 0.317 | 0.294 | 0.611 | 0.400 | 0.693 |
| 0.5 | 0.423 | 0.392 | 0.815 | 0.533 | 0.925 |
| 0.625 | 0.529 | 0.490 | 1.019 | 0.666 | 1.156 |
| 0.75 | 0.635 | 0.588 | 1.223 | 0.799 | 1.387 |
| 0.875 | 0.741 | 0.686 | 1.427 | 0.932 | 1.618 |
| 1 | 0.847 | 0.784 | 1.630 | 1.065 | 1.849 |
| 1.25 | 1.058 | 0.980 | 2.038 | 1.332 | 2.312 |
| 1.5 | 1.270 | 1.176 | 2.446 | 1.598 | 2.774 |
| 2 | 1.693 | 1.568 | 3.261 | 2.131 | 3.698 |
| **Step-up** | 118.1 | 127.6 | 61.3 | 93.9 | 54.1 |
| **Fixed discount** | -22.3 | -16.5 | -16.5 | -12.2 | -12.2 |

| OPTION VALUE<br>Disc: USD BBB | with 50% prob /4.5% fixed coupon<br>Step structure | | | | |
|---|---|---|---|---|---|
| **Coupon step** | **3s5s** | **5s7s** | **3s7s** | **7s10s** | **5s10s** |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.125 | 0.100 | 0.091 | 0.190 | 0.120 | 0.210 |
| 0.25 | 0.200 | 0.181 | 0.381 | 0.240 | 0.421 |
| 0.375 | 0.300 | 0.272 | 0.571 | 0.360 | 0.631 |
| 0.5 | 0.400 | 0.362 | 0.762 | 0.480 | 0.842 |
| 0.625 | 0.500 | 0.453 | 0.952 | 0.599 | 1.052 |
| 0.75 | 0.599 | 0.543 | 1.143 | 0.719 | 1.263 |
| 0.875 | 0.699 | 0.634 | 1.333 | 0.839 | 1.473 |
| 1 | 0.799 | 0.724 | 1.524 | 0.959 | 1.683 |
| 1.25 | 0.999 | 0.906 | 1.905 | 1.199 | 2.104 |
| 1.5 | 1.199 | 1.087 | 2.286 | 1.439 | 2.525 |
| 2 | 1.599 | 1.449 | 3.047 | 1.918 | 3.367 |
| **Step-up** | 125.1 | 138.0 | 65.6 | 104.3 | 59.4 |
| **Fixed discount** | -23.2 | -17.4 | -17.4 | -13.0 | -13.0 |

[16] These calculations are indicative, assuming annual coupons and other simplifications. More exact calculations are forthcoming.

[17] A credit-default swap (CDS) can in this context be understood as a synthetic bond.

**Table 2.10** (left) EUR B discount curve; (right) EUR BBB discount curve assuming 100% step probability

| OPTION VALUE | with 50% prob /4.5% fixed coupon | | | | |
|---|---|---|---|---|---|
| Disc: EUR B | Step structure | | | | |
| Coupon step | 3s5s | 5s7s | 3s7s | 7s10s | 5s10s |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.125 | 0.091 | 0.079 | 0.170 | 0.100 | 0.179 |
| 0.25 | 0.182 | 0.158 | 0.341 | 0.200 | 0.358 |
| 0.375 | 0.273 | 0.238 | 0.511 | 0.300 | 0.538 |
| 0.5 | 0.365 | 0.317 | 0.682 | 0.400 | 0.717 |
| 0.625 | 0.456 | 0.396 | 0.852 | 0.500 | 0.896 |
| 0.75 | 0.547 | 0.475 | 1.022 | 0.600 | 1.075 |
| 0.875 | 0.638 | 0.555 | 1.193 | 0.700 | 1.254 |
| 1 | 0.729 | 0.634 | 1.363 | 0.799 | 1.433 |
| 1.25 | 0.912 | 0.792 | 1.704 | 0.999 | 1.792 |
| 1.5 | 1.094 | 0.951 | 2.045 | 1.199 | 2.150 |
| 2 | 1.459 | 1.268 | 2.726 | 1.599 | 2.867 |
| Step-up | 137.1 | 157.7 | 73.4 | 125.1 | 69.8 |
| Fixed discount | -24.5 | -18.7 | -18.7 | -14.4 | -14.4 |

| OPTION VALUE | with 100% prob /4.5% fixed coupon | | | | |
|---|---|---|---|---|---|
| Disc: EUR BBB | Step structure | | | | |
| Coupon step | 3s5s | 5s7s | 3s7s | 7s10s | 5s10s |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 0.125 | 0.212 | 0.196 | 0.408 | 0.266 | 0.462 |
| 0.25 | 0.423 | 0.392 | 0.815 | 0.533 | 0.925 |
| 0.375 | 0.635 | 0.588 | 1.223 | 0.799 | 1.387 |
| 0.5 | 0.847 | 0.784 | 1.630 | 1.065 | 1.849 |
| 0.625 | 1.058 | 0.980 | 2.038 | 1.332 | 2.312 |
| 0.75 | 1.270 | 1.176 | 2.446 | 1.598 | 2.774 |
| 0.875 | 1.482 | 1.372 | 2.853 | 1.864 | 3.236 |
| 1 | 1.693 | 1.568 | 3.261 | 2.131 | 3.698 |
| 1.25 | 2.117 | 1.960 | 4.076 | 2.663 | 4.623 |
| 1.5 | 2.540 | 2.352 | 4.891 | 3.196 | 5.548 |
| 2 | 3.386 | 3.135 | 6.522 | 4.261 | 7.397 |
| Step-up | 59.1 | 63.8 | 30.7 | 46.9 | 27.0 |
| Fixed discount | -22.3 | -16.5 | -16.5 | -12.2 | -12.2 |

In this bond structure, if the step happens and is correlated with an (increase) in credit risk,[18] one could think about how that additional credit risk could be hedged through default pricing on that part of the curve. In theory, the 5x2 CDS forward (sell 5yr CDS protection, buy 7yr CDS protection) can be used to hedge that additional risk.[19,20]

The amount of forward protection that has to be bought will be related to i) the step probability and ii) the increase in credit risk due to the step up. If we assume that i) the step probability is given exogenously, and ii) that there is a 1-for-1 relationship between the sustainability metric and credit risk, an investor should be indifferent to buying a vanilla bond or buying an SLB with a matched forward. This means we can then set the value of the SLB option premium equal to that of the forward protection.[21]

Of course, many SLB issuers will not have outstanding CDS curves traded on their names. Still, by extrapolating the value of forward protection from similar names (in terms of ratings, sectors or similar metrics), it is likely that useful information around forward pricing can still be achieved.[22] This also means that if SLB step-ups and maturities are set to the standard points on the curve (3yr, 5yr, 7yr and 10yr), the instrument would be more easily hedged and priced, which is the reason a terminology like "standardised greenback" could be useful.

[18] We discuss correlation of credit risk and SLB steps in Chapter 6.

[19] This is equivalent to conditional curve trades that have been used in CDS index space. Buying forward protection, as suggested here, is equivalent to a "steepener" trade (with flat nominals rather than DV01 weights). Eg, "CDS Curve Trading Handbook 2007", p.113ff., Barclays Capital, Feb 2008.

[20] In the limit case, the SLB is the outstanding bond deliverable into the CDS contract (eg, being the longest maturity bond on the curve). In this case, one could also make the forward risk directly linked to the SLB coupon-step size.

[21] There are considerable practical issues here, not least that CDS forward trade in a non-true format, i.e., there are cash-flows prior to the forward start-date. This should, however, from a pricing perspective, not be a major issue.

[22] Further questions arise in terms of how much forward protection should be bought in terms of hedging spread widening – the option "delta".

# 03

# SLBS AS A FIXED INCOME PORTFOLIO TOOL

# 03 SLBS AS A FIXED INCOME PORTFOLIO TOOL

## SECTIONS



## CASE STUDIES

"SLBs offer high complementarity to other investable instruments, allowing investors to maximise portfolio potential."

## 3.1 OVERVIEW

Bond investors seek returns. Specifically, risk-adjusted returns. Even more specifically, risk-adjusted returns with as much liquidity as possible. On top of this, many investors want to have 'impact', where 'impact' can be defined as the sum of positive and negative externalities being financed by the borrower's investment in real economy activities.

Combining several, sometimes competing, objectives of an investment is at the core of 'portfolio construction'. An asset might have low liquidity; how much extra return ('illiquidity premium') do you need to compensate for that? Something might have a great externality effect, but low expected return (such as a malaria vaccine); can an investor justify the investment? Many of the questions around risk, return, liquidity, and impact cannot be answered without knowledge of the investor's preferences. What is right for one investor may not be for another.

**This chapter focuses on three generalised types of SLB investors: those looking at SLBs for pure excess return purposes, the ones who use SLBs for hedging correlated sustainability and credit risk, and finally those focused on impact.** Of course, most investors will be a combination of these types.

Irrespective of their preferences, investors that want to achieve their goals need to explore the full range of instruments available to them. **SLBs serve as an additional tool, with high complementarity to other investable instruments, adding value and allowing investors to maximise portfolio potential**. As we discuss in the final section of the chapter, the 'interoperability' of SLBs with vanilla bonds is an important aspect of their value proposition.

## 3.2 THREE PORTFOLIO PERSPECTIVES ON SLBS

There are three main perspectives to using SLBs in a portfolio context:

- An investor can look to simply extract under- or over-priced priced (option) value in an SLB to generate excess returns (**"alpha generation"**).
- An investor can look to optimise risk under the assumption that there is correlation between the credit quality of issuers and their achievement of sustainability targets (**"sustainability risk hedging"**).
- An investor has a mandate to invest in a way that brings about positive sustainability results, even though it may not offer improved risk-return metrics (**"impact investing"**).

The **SLB alpha-generation** approach centres on whether an SLB, with its extra-financial features, is priced in a way that properly reflects the intrinsic value or other factors that may cause it to generate excess returns. Historically, there has been relatively little focus on this perspective, but by highlighting certain case studies (see next section), more mainstream investors could be tempted to look to SLBs for pure excess return purposes.

Under the **sustainability risk/return-correlation approach**, an investor seeking to hedge correlated sustainability/financial performance risk can utilise an SLB so that its coupon step-up coincides with changes in the issuer's risk profile. For example, an investor could supply capital to a 'dirty' company under the investment hypothesis that the company is transitioning (into less dirty activities) and thereby will be a lower financial risk in the future. If the company fails to transition, the investor then receives a higher yield as compensation through a coupon step-up.

The **impact investor** will look at the same company, and say that through the step-up structure the bond (and therefore the investor) is creating incentives for the company to transition. When the company transitions, the investor can assume some credit for that – and the associated positive externalities – and count them toward their overall portfolio impact. The step-up operates as compensation if an issuer is not able to provide that impact service to the investor. Later in this chapter we will discuss the non- or quasi-financial utility that SLBs provide in the form of **high-level sustainability commitments** to the issuer and **increased transparency** on sustainability data (and implicitly governance strength).

## 3.3 ALPHA GENERATION

Our chapters on pricing (Chapter 2 and 5) show that the special features of SLBs can be priced. This means they can also be mispriced, opening up opportunities for investors. Taking advantage of such mispricing is the obvious way to generate alpha through SLBs. Examples of relative value assessments, and the potential for mispricing, are highlighted in Cases 9-12.

In the first of these cases (Case 9), an Enel SLB (0% 2027) with an at the time still to be observed 2023 SPT, traded wider (with a higher spread) than another SLB (0.375% 2027) where the observation had already happened.

However, as the market saw an increased probability that the 2023 target would be missed, the 0% started outperforming the 0.375% on a relative basis. This reflected the consensus that the coupon on the 0% would step up. Indeed, when an announcement came in late April 2024 (just prior to the publication of this book), there was a further strong rally of the Enel SLBs that would see the step-up.

Case 10 presents a situation where the market simply does not seem to price even a certain increase in coupon payments, a bit different to the sharp moves in the Enel curve. That such technical details are not immediately priced out is indeed one of the attractive features of credit, and illustrates how there may be excess returns in steps even when the step has already been announced.

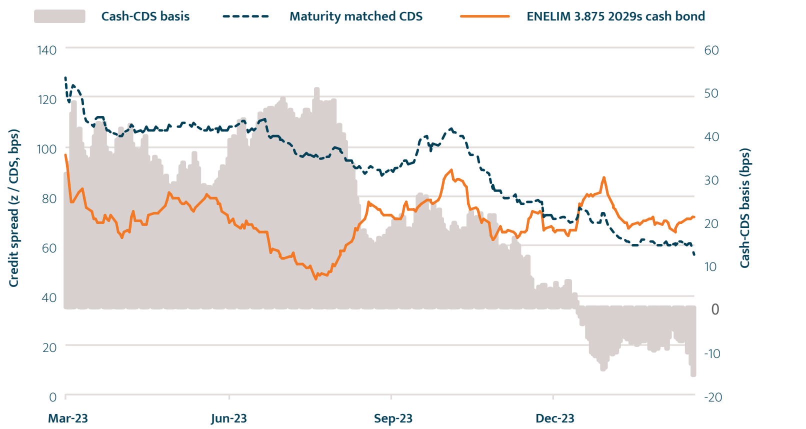
Case 11 provides an ex-ante relative value analysis of an SLB, focused on Swiss pharmaceutical firm Novartis. As most SLBs are step-ups, the optionality is positive for investors, and holding everything else equal, such SLBs should be at least as valuable as traditional bonds. Of course, this value is tempered by other potential valuation factors such as liquidity and other technical drivers. Such relative value situations will often come directly into play in the primary market, where SLBs are sometimes launched alongside traditional and even green bonds. Case 12 illustrates this, where Dutch supermarket chain Ahold issued vanilla, green, and SLB debt in one go, with the latter looking particularly cheap.

As SLB proceeds are for general corporate purposes, they are instruments well suited to general credit risk premium trades. Historically, the spread premium – particularly on investment grade bonds – has more than compensated for the underlying credit risk.[1] An investor that views credit risk premia in terms of extracting alpha/excess returns may use SLBs – if priced fairly – to express this view alongside traditional corporate bonds.

[1] See for example "The Credit Risk Premium", Asvanunt, A. and Richardson, S., The Journal of Fixed Income 2017 26:3.

Lastly, the flexibility and interoperability (discussed in the final section of the chapter) of the SLB also allow the bonds to be used as the legs for general types of credit trades: cash bond relative value and cash-CDS basis trades, for example. See Figure 3.1 concerning Enel for an illustration. Here, the basis went from substantially positive in early 2023 to negative in 2024, suggesting outperformance of the CDS versus the SLB.[2] On the flip side, at the end of the period, the negative basis means that an investor could buy the SLB and buy CDS protection which would neutralise default risk, but still retain the SLB optionality.

**Figure 3.1** Examples of vanilla bond – SLB cash bond relative value, and SLB-CDS basis spreads. ENELIM EUR3.875/ 03/2029 vs matched CDS




SOURCE: AFII, Bloomberg

[2] This was a general market development over time and not directly related to the issuers' credit performance.

# CASE STUDY 9
## CAN SLB OPTION PREMIUMS BE TRADED? ENEL

**RESEARCH:** ENEL SLBS: MARKET UPDATE, NOV 2023

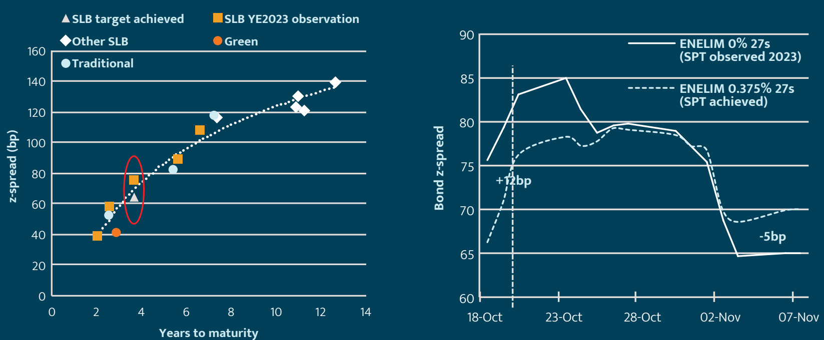
**BOND:** ENELIM EUR0% 06/27 (XS2353182020), ENELIM EUR0.375% 06/27 (XS2066706909)

**Historically, it has been hard to observe SLB option premiums in the market, as they have been relatively small compared to general market technicals and volatility.**

**In October 2023, there were significant moves within the EUR Enel bond curve; bonds with a step-up depending on the Dec 2023 SPT outperformed compared to both non-SLBs and SLBs whose targets had already been achieved (Case figure 9.1 shows performance for the EUR 2027 pair). SLBs with later targets outperformed to a lesser extent, seeming to indicate that missing a target in Dec 2023 would increase the chances of Enel missing subsequent targets.**

**This strong performance from the SLBs showed the step-up option has value to investors. Despite exogenous shocks being a factor in Enel's emissions trajectory, the fact that a target could be missed shows there was ambition in its calibration; that its achievement was never guaranteed. Secondary bond price tightening confirms that ambitious targets are rewarded with lower spreads, which we expect to feed through into delivering tighter primary costs-of-capital to issuers of ambitious SLBs.**

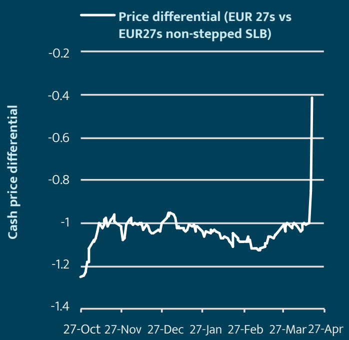
**Further analysis can be read in: Enel SLBs: FY 2023 generation figures released, Mar 2023.**

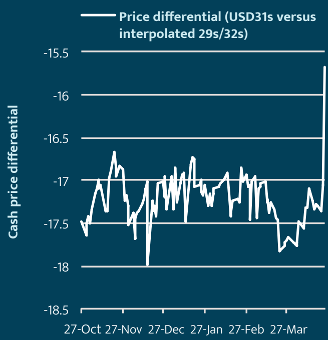



**Case figure 9.1** (left) Enel bond curve, Oct 23; (right) Enel SLB relative value, 7 Nov 2023. Source: Bloomberg

**At the time of publication of this book (April 2024), Enel announced that the SPTs had not been achieved and that coupon step-ups for the Dec 2023 SPTs would start to accrue. With a total of USD11bn of Enel bonds being affected, this constituted a major event for the SLB market.**

**In the first day following the announcement, Enel bonds experienced substantial price moves. In EUR, the ENELIM EUR0%27 SLB, which is stepping up, rallied around 60c versus the non-stepping EUR0.375% 27 equivalent (Case figure 9.2, left panel). In USD, the ENELIM USD2.25 31s, which is stepping up, rose by more than USD1.5 versus and interpolated price curve. The Enel case clearly proves the value of optionality in the SLB structure.**




**Case figure 9.2** SLB price moves following the announcement of coupon step-ups in select Enel bonds, April 2024. (left) EUR; (right) USD. Source: Bloomberg

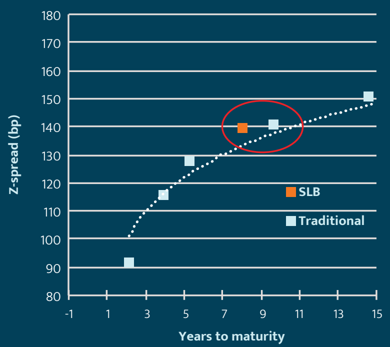
## CASE STUDY 10
### A STERLING SLB TRADE: LONDON & QUADRANT HOUSING TRUST

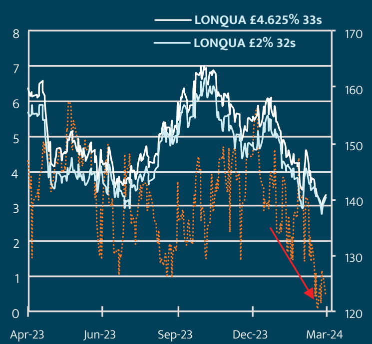
**ARTICLE: L&Q HOUSING TRUST SLB 'BUILDS' IN A COUPON STEP-UP, MAR 2024**

**BOND: LONQUA GBP2% 03/32 (XS2430702105)**

**London & Quadrant Housing Trust (ticker LONQUA), a UK-based residential developer and housing association, issued a £300mn SLB in Jan 2022. The bond had three SPTs observed in Mar 2024: to reduce Scope 1 + 2 emissions by 20%, to achieve a minimum average energy efficiency, and to build new affordable homes.**

**On 20 Mar 2024, it announced that the first SPT would likely be missed leading to a 12.5bps step-up in the bond coupon, effective Sep 2024. The step of 7.5bps would apply for the remaining eight years of the bond, and so should translate into a tightening of nearly 12bps on a running basis. With the £32s trading wide to the curve and flat to the longer £33s, there appears to be a substantial potential for repricing higher.**




**Case figure 10.1** (left) LONQA GBP curve (0-15yrs), with the GBP32 SLB and the vanilla GBP33s highlighted; (right) and spread, as of March 2024. Source: Bloomberg

# CASE STUDY 11

## SLBS FOR BOND RELATIVE VALUE: NOVARTIS

**RESEARCH: NOVARTIS SLB: TWIN BOND DIVERGENCE, NOV 2023**

**BOND: NOVNVX EUR0% 09/28 (XS2235996217)**

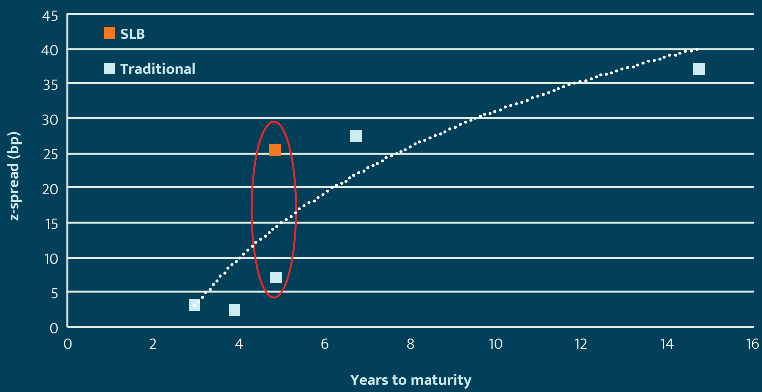
Novartis AG, a Swiss-based manufacturer of pharmaceuticals and consumer healthcare products, has been a regular issuer in the corporate bond markets for many years. In September 2020, it issued its first SLB into the Eurobond market.

The bond specified two KPIs linked to increasing its 'Patient Reach' in low- and middle-income countries. The associated SPTs have an observation date in 2025. Novartis' target is to increase the number of patients reached with 'Strategic Innovation Therapies' by 200% compared to 2019, and the number of patients reached with 'Flagship Programs' by 50% compared to 2019.

In its 2022 Integrated Report, Novartis highlighted the good progress it had made and noted that it was on track for achieving its SPTs. Historical KPI data, however, has been volatile, and there remains uncertainty over whether the targets will be achieved. Our analysis estimates the SLB could have an option value of 5bps.

The Novartis SLB (ISIN XS2235996217) has a 'twin bond', NOVNVX 0.625 09/20/28 (ISIN XS1492825481). The bonds are nearly maturity matched and their coupons are similar. The presence of a 'twin bond' enables easy pricing comparison. While these two bonds have historically traded closely, they have also experienced periods of divergence.

The vanilla bond is eligible to be purchased by the ECB's corporate bond purchase program (CSPP), whereas the SLB is not. As the ECB reduces its CSPP holdings, we would expect that flows could further support a convergence between these bonds.




**Case figure 11.1** Novartis EUR bond z-spreads. Source: Bloomberg, accessed 20 Nov 2023

# CASE STUDY 12
## ALPHA GENERATION IN PRIMARY MARKETS: AHOLD

**RESEARCH:** RELATIVE VALUE IN THE EYE OF THE AHOLD-ER, MAR 2024

**BOND:** ADNA EUR3.875% 03/36 (XS2780025511)

On 4 March 2024, Ahold (ticker ADNA), a Belgian-Dutch multinational retail company, brought a three-tranche deal to market. What made this deal notable was that it combined vanilla, green and sustainability-linked debt in a single transaction, and comprehensive targets in the SLB specifically.

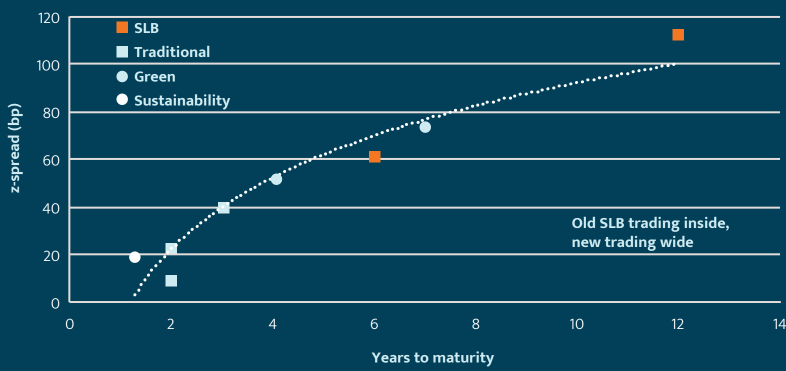
From a relative value perspective, the issued vanilla FRN seemed to be trading quite tight, at nearly half the spread of the similar maturity 1.125% 26s. At issuance it was reported to have priced with a -8bps concession, i.e. 8bps inside the secondary bond curve, with the short-dated FRN being described as 'rare'.

The focus of Ahold's UoP debt has been capex/opex, primarily to lower Scope 1 + 2 emissions and associated climate impacts. Its initial sustainability framework was tightened and converted into a green framework, and when deployed for the concurrently issued green bond, the EUR3.375 2031s, it took the largest part of the total order book and was issued with a 2bps greenium (inside the curve).

Compared to the green 2031 bond, the old SLB, the 0.375% 30s, seemed also to be pricing inside the curve, suggesting the market was valuing the step-up option. A premium of 10bps implies a 60% probability of the target being missed, and the 25bps step-up being activated.

The framework used for the new SLB, the 3.875% 36s, lowered the interim 2025 SPT targets. AFII interpreted this as a sign of confidence from Ahold that the earlier 2025 targets, as referenced in the old SLB, would be achieved, information which may not have been digested by the market at the time.

The shape of the curve, shown in Case figure 12.1, indicated that the new 36s SLB were trading outside the curve, even without accounting for the added optionality that seemed priced into the 30s (that seemed to have logically had a lower probability for step-up/option value in spread terms).




**Case figure 12.1** Novartis EUR bond z-spreads. Source: Bloomberg, accessed 20 Nov 2023

### 3.3.1 SLB ALPHA AND FORECASTING TARGET ACHIEVEMENT

Central to generating alpha in the above case studies is determining the likelihood of the coupon step-up paying out. As discussed in the previous chapter, this necessitates an understanding of the role probabilities play in SLB valuations.

Assuming that SLB targets are quantifiable/somehow forecastable (more on this in Chapter 5), the question is how investors and analysts should actually go about generating step-up forecasts. This has not been thoroughly researched to date, but as it is central to the SLB value proposition, we expect further exploration of this area going forward.

Currently, we see four main avenues for estimating step probabilities. Managers are likely to apply some or all of them in parallel when estimating probabilities:

- **Fundamental analysis:** Forecasting capital expenditure and the impact of capex spending on key performance metrics based on fundamental data and company analysis is an obvious approach to infer step probabilities. Such analysis will also consider the effect of external factors on a company, such as commodity prices ("if fossil fuel prices go up/down, is the company more or less likely to achieve SPTs?") and policies ("how likely is it that the company's clients in a certain region come under carbon border tax mechanisms?"). An example of this approach is presented in Case 13.
- **Cross-section:** Sector reviews are aggregated fundamental analyses. They are very useful for understanding if a particular issuer's targets are likely to be met or not by comparing it to a peer group. We provide one such cross-section review for the airport sector in "Cross-section analysis of step probabilities: Airports" in Chapter 4, as well as a longer sector study on the chemicals sector.
- **Surveys:** In Chapter 2, we brought up a recent survey indicating how corporates see the probability that they themselves will reach net-zero targets vis-à-vis how likely they believe it is that their peers will do so (Figure 2.2). Another survey approach is to aggregate research analyses on a particular topic, for example on emissions forecasting, and infer probabilities from those analyses.
- **Time-series analysis:** This is the process of observing trends and volatility of historical data and using this data to generate a probability distribution of the likelihood that the target variable will be below or above a certain threshold (the SPT) in the future. Our pricing framework relies on a fairly simple underlying time-series model, though one

can imagine more sophisticated approaches that use techniques such as Markov chains or Monte Carlo analysis.

These four approaches are labour intensive. Issuers that have designed overly complex, and even counterintuitive, SPTs (we give an example in Case 20), have not helped investors to price step probabilities either. Simpler structures with fewer SPTs are preferable, as they would, over time, help investors to generate implied probabilities for target achievement derived from market prices.

Just because pricing step probabilities is difficult, does not mean it should not be done. At a very basic level of credit investing, understanding the probabilities of reaching certain thresholds are central; an investor who buys a bond at a BBB+ rating evaluates the probability that the bond is downgraded to BBB (thus suffering a lower valuation) that it stays at BBB+, or improves to A-. An example of this type of analysis is shown in Table 3.1, where probabilities for investment grade credits staying in the same rating category over a five-year period is around 50%, which coincidentally is fairly close to the probabilities related to achieving some of the SPTs in this book. An investor looking to invest in a bond with a 10yr maturity will explicitly or implicitly think around a matrix of transition probabilities like those in this table. Indeed, thinking about 5yr sustainability objectives for a 10yr SLB structure may in fact even be easier than constructing an outright view on credit risk probabilities

**Table 3.1** Five-year global corporate rating transition matrix (1981-2023). Source: S&P Global Ratings

| | AAA | AA | A | BBB | BB | B | CCC/C | D | NR |
|---|---|---|---|---|---|---|---|---|---|
| AAA | **50.0%** | 28.7% | 4.7% | 0.9% | 0.2% | 0.2% | 0.1% | 0.3% | 14.9% |
| AA | 1.3% | **53.3%** | 23.9% | 3.3% | 0.5% | 0.3% | 0.0% | 0.3% | 17.0% |
| A | 0.1% | 4.5% | **59.1%** | 14.0% | 1.7% | 0.6% | 0.1% | 0.4% | 19.5% |
| BBB | 0.0% | 0.3% | 9.9% | **54.9%** | 7.2% | 1.8% | 0.3% | 1.5% | 24.0% |
| BB | 0.0% | 0.1% | 0.8% | 11.9% | **34.7%** | 10.9% | 1.1% | 6.1% | 34.4% |
| B | 0.0% | 0.0% | 0.2% | 1.2% | 9.1% | **26.2%** | 3.5% | 16.7% | 43.2% |
| CCC/C | 0.0% | 0.0% | 0.1% | 0.6% | 2.5% | 11.9% | **2.6%** | 47.2% | 35.1% |

# CASE STUDY 13

## FUNDAMENTAL ANALYSIS OF SPTS: ENEL

**RESEARCH: A REVIEW OF SLBS APPROACHING KPI OBSERVATION DATES, NOV 2022**

**BOND: ENELIM GBP1% 10/27 (XS2244418609)**

The ENELIM £1% 27 SLB has an SPT that commited Enel to have installed renewable capacity equivalent to 60% of its total capacity by 31 Dec 2022. The following analysis was written before this target's observation date. Enel subsequently achieved this target, and thus the SLB paid no step-up.

Case figure 13.1 shows Enel's generation capacity in 2021 and 2022. The target given for 31 Dec 2021 renewable energy generation was 55%. Actual performance exceeded this significantly, with an achieved level of 57.5% (of 87.1 GW total installed capacity). Interim reporting at Q1 and H1 showed that progress was being made, but with a renewable capacity increase of just 0.7% in H1, Enel needed to extend renewable capacity another 1.8% in H2 to meet its target for the end of the year.

| | FY 2021 MW | PERCENTAGE | Q1 2022 MW | PERCENTAGE | H1 2022 MW | PERCENTAGE |
|---|---|---|---|---|---|---|
| Hydro | 27,847 | 32% | 28,384 | 32.2% | 28,351 | 32.0% |
| Wind | 14,903 | 17% | 14,981 | 17.0% | 15,256 | 17.2% |
| Geothermal | 915 | 1% | 915 | 1.0% | 915 | 1.0% |
| Solar & other | 6,401 | 7% | 6,860 | 7.8% | 7,040 | 8.0% |
| Nuclear | 3,328 | 4% | 3,328 | 3.8% | 3,328 | 3.8% |
| Oil & Gas | 11,715 | 14% | 11,694 | 13.3% | 11,689 | 13.2% |
| Coal | 6,910 | 8% | 6,910 | 7.8% | 6,910 | 7.8% |
| CCGT | 15,039 | 17% | 15,039 | 17.1% | 15,039 | 17.0% |
| TOTAL | 87,058 | 100% | 88,111 | 100.0% | 88,528 | 100.0% |
| TOTAL Renewable | 50,066 | 57.5% | 51,140 | 58.0% | 51,562 | 58.2% |

**Case table 13.1** Enel generation capacity. Source: Enel

At the time of writing, this appeared to be achievable given Enel had announced several projects with target capacity increases before the end of the year. In September, Enel Chile disconnected its final coal-power plant, Unit II of Bocamina, and reported that it expected to connect 500 MW of new renewable capacity.

In Spain, Enel Green Power had many projects under development. In Extremadura there are five solar projects of approximately 49.5 MW each, which came into operation before the end of the year, adding another 250 MW of capacity. Another 50 MW was projected to be in production by year end coming from the Sedeis V solar plant. In Castilla La Mancha, there are five/seven solar and three wind plants under construction, slated to contribute just under 500 MW by the end of the year.

In October, Enel finalised the sale of its entire stake in PJSC Enel Russia (announced 16 Jun 2022). As a result of this transaction, Enel disposed of all its Russian power generation assets, which include approximately 5.6 GW of conventional capacity and around 300 MW of wind capacity at different stages of development. While this does not reduce emissions, it does effectively adjust the denominator of the KPI ratio.

## 3.4 SUSTAINABILITY-CORRELATED RISK HEDGING

More than alpha generation, the likely purpose of an SLB in many portfolio contexts is to operate as a hedge against companies not performing in line with their sustainability targets. In case of failure, the step-up to the SLB coupon provides compensation for the increased risk.

"Risk" is often synonymous with "creditworthiness" in the bond space, and therefore a central question is: does creditworthiness actually correlate with sustainability performance?

The big three rating agencies, often considered to be the arbiters of creditworthiness, incorporate ESG criteria into their corporate and sovereign credit risk analyses,[3] although they do not explicitly disclose whether their impacts are positive or negative.[4] S&P gives more detail on the specific ESG credit factors that are considered to have a material impact on credit, depending on whether they represent a risk or an opportunity:

*"Climate transition risk and physical risk-related factors may be among the most significant ESG credit factors that affect the creditworthiness of rated entities. This is primarily because of policymakers' efforts to reduce emissions or to ensure that greenhouse emissions reflect their full social costs ("climate transition risk") and climate change, which is leading to more frequent and severe extreme weather events ("physical risk")."*[5]

Over time, climate-related themes have started to appear more frequently in rating agency reports, especially in stranded asset/activity types of cases. As an example, S&P "junked" Port of Newcastle, the world's biggest coal export terminal, and its bonds based on the company's dependence on coal, for which the rating agency saw accentuated risks.[6] Many other examples exist.

The idea that a change in creditworthiness results in a change in coupons should not be alien to investors. In the hybrid bond space, step-up coupons have long been linked to credit rating changes.

When considering the market reaction to a missed SPT, the question of how environmental performance impacts pricing is a topic of much research. It has been concluded that the impact of ESG factors is greater for credit performance than equities, and environmental factors specifically impact credit negatively as a stress factor.[7]

It has also been shown that higher carbon emissions and carbon intensities can impact the market's view of default-likelihood, perhaps due to anticipated policy responses.[8]

Case 14 unpacks the Japanese sovereign's decarbonisation approach, and the assumption that a credit investor takes less downside risk if the country achieves its carbon reduction targets. On a country level, reduced carbon emissions can be interpreted in several ways when it comes to credit risk: reduced fossil fuel dependency reduces the likelihood of contractionary economic measures (as seen in the aftermath of Russian's invasion of Ukraine in Europe); reduced carbon emissions could lower costs to an economy if there ever were a discussion around global carbon taxes; and/or a successful decarbonisation could indicate that an economy has transitioned to a more efficient economic model.

Given these effects, the assumption that SLB coupon variability could change due to success (or failure) to meet decarbonisation targets is not particularly outlandish.

[3] An overview of the different criteria considered by the three rating agencies is given in "How sustainability risks factor into credit ratings", Nordea, 9 Nov 2022.

[4] Although it is assumed risks contribute to deteriorations in ratings.

[5] "General Criteria: Environmental, Social and Governance Principles in Credit Ratings", S&P Global Ratings, 10 Oct 2021.

[6] "Port of Newcastle junked as debt wall approaches", AFII, 7 Sep 2023.

[7] See "ESG factors for predicting changers to CDS spreads", S&P, 27 Oct 2022.

[8] Please see "Climate Change and Credit Risk", Capasso, Gianfrate & Spinelli, 2020.

# CASE STUDY 14

## HEDGING OUTCOMES USING SLBS: JAPAN SOVEREIGN

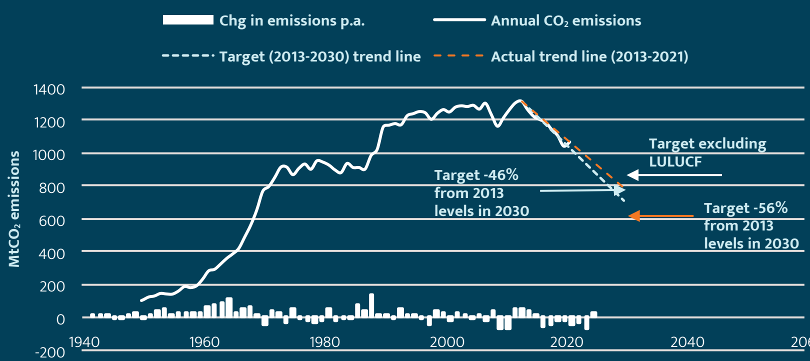
**RESEARCH: TRANSITION POWER, A JGB SLB, PRINTS IN USD, FEB 2024**

**Japan is one of the world's most fossil-fuel dependent countries and is almost 100% reliant on energy imports. Given the volatility of fossil fuel prices, plus an increase in geopolitical volatility that may interfere with fossil fuel supply chains, high continued dependency on fossil fuels is likely to translate to higher credit risk for the Japanese sovereign and its sub-entities. The Japanese GX ("transition") plan is a response to this, and an ambition to significantly reduce greenhouse gas emissions.**

**To address both emissions as well as potential credit risk, AFII proposed hypothetical deal terms for a general corporate purpose (GCP) bond in SLB format, to complement use-of-proceeds GX bonds. The bond proposal is structured to pay a step-up in case targets are missed, and a step-down if there is a significant overachievement.**

| | |
|---|---|
| Maturity | 10y, Feb 2034 |
| Observation and step date | Feb 2031 |
| SPT 1 | -46% $CO_2$ reduction at 2030 from 2013 baseline, equivalent to ~710Mt pa. |
| SPT 2 | -56% $CO_2$ reduction at 2030 from 2013 baseline, equivalent to ~579Mt pa. |
| Coupon adjustment | +37.5bp on not achieving SPT1<br>-37.5bp on achieving SPT2 |
| Pricing | JGB USD curve -5.8bp |
| of which: | -6.6bps option value of SPT1 |
| | +0.8bps option value of SPT2 |
| | Indicatively TSY10+13.2bp |

**Case table 14.1** Sample term sheet for a Japanese sovereign (JGB) SLB with a step-up/step-down structure and an investor option value of 5.7bps. Indicative pricing. Source: AFII




**Case figure 14.2** Historical $CO_2$ emissions and forward projections, 1940–2030. Sources: JapanGov: Carbon neutrality, How Japan could reach carbon neutrality by 2050 | McKinsey, AFII.

**Table 3.2** Hypothetical pricing for an SLB with a duration of 5, for a 25bps (top panel) / 5bps (bottom panel) spread move

| | MID SPREAD | DURATION | SLB BASE COUPON | SLB STEP | SLB OPTION PROBABILITY | SLB VANILLA PRICE | SLB OPTION PREMIUM | SLB PRICE | EVB COUPON | EVB PRICE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00% | 5.000 | 0.875% | 0.250% | 50% | 99.4% | 0.6% | 100.0% | 1.00% | 100.0% |
| SPT ACHIEVED | 0.75% | 5.000 | 0.875% | 0.250% | 0% | 100.6% | 0.0% | 100.6% | 1.00% | 101.3% |
| SPT MISSED | 1.25% | 5.000 | 0.875% | 0.250% | 100% | 98.1% | 1.3% | 99.4% | 1.00% | 98.8% |
| | | | | | | **MOVE** | | **0.6%** | < | **1.3%** |

To study the hedging effect structurally, Table 3.2 presents hypothetical pricing for an SLB that has a positively correlated spread move on achieving/missing its SPT. Here, we assume a 25bps/5bps spread move wider if the SPT is not met, and an analogous tightening if met.

In the first example, upon SPT achievement/miss, the vanilla bond moves from 100 to 101.3/98.8 in price terms. In comparison, the SLB has a price change to 99.4 if the SPT is missed, as the option premium is crystallised. On the flip side, the SLB does not rally as much if the SPT is achieved, only to 100.6. So, in this example, the SLB reduces volatility in outcomes to 0.6 in price terms, compared to 1.3 in the EVB case. This would be the archetypal way a hedge would operate – reduce downside at the cost of some upside.[9] If we assume that an investor is risk-averse rather than risk-neutral, this lowered volatility could motivate a premium.[10]

In the example at the bottom of Table 3.2, the spread move is smaller, just 5bps. In this case, the SLB is arguably over-hedged versus the SPT, as the SLB will outperform all other bond scenarios (100.4 in price versus 100.3 at most for any other combination) if the issuer fails on the SPT. One conclusion from this: if there is weak correlation or just weak spread expectation effects focused on the SPTs, there may be more reason to be concerned around the SLB being seen as "monetising failure."

The above example omitted two further complications: convexity and skew. Convexity in the outcomes originates from the fact that the duration of the bond increases when the spread tightens and decreases when it widens. This means that the price increases more on the upside than it falls on the downside. This asymmetry means that, everything else being equal, the SLB will underperform an EVB if there are spread moves due to correlation with the SPT. However, as illustrated in Table 3.3 (on the next page), this effect may be quite small for most of today's SLB structures: the SLB and the EVB trade at a difference on the fourth decimal due to convexity.

In option dynamics, it is observed that volatility has a "smirk" – downside volatility trades at a higher implied level than upside volatility. Table 3.4 gives hypothetical pricing considering this skew. This is represented as a 50bps widening on missing the SPT with only a 25bps tightening if the SPT is achieved. In this situation the SLB has a higher average value, such that the skew effect negates and exceeds the (negative) convexity effect for the investor.

| | MID SPREAD | DURATION | SLB BASE COUPON | SLB STEP | SLB OPTION PROBABILITY | SLB VANILLA PRICE | SLB OPTION PREMIUM | SLB PRICE | EVB COUPON | EVB PRICE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00% | 5.000 | 0.875% | 0.250% | 50% | 99.4% | 0.6% | 100.0% | 1.00% | 100.0% |
| SPT ACHIEVED | 0.95% | 5.000 | 0.875% | 0.250% | 0% | 99.6% | 0.0% | 99.6% | 1.00% | 100.3% |
| SPT MISSED | 1.05% | 5.000 | 0.875% | 0.250% | 100% | 99.1% | 1.3% | 100.4% | 1.00% | 99.8% |
| | | | | | | **AVERAGE MOVE** | | **0.4%** | > | **0.2%** |

9 We assume somewhat counterintuitively that outcomes in terms of spread changes are symmetrical. We relax this further down.

10 Reduced volatility of green bonds is often cited as a reason for their trading at lower spread levels than equivalent non-green assets. This is explored in detail, concluding that volatility differences cannot be universally observed, in "Green Bond Risk Premiums: A Twin-Bond ULFP Approach", Ulf Erlandsson, 2 Jun 2020.

**Table 3.3** Hypothetical pricing for an SLB with convexity. Durations are calculated using Bloomberg YAS and ENELIM 0.375% 27s, calculated 20 Jan 2023

| | MID SPREAD | DURATION | SLB BASE COUPON | SLB STEP | SLB OPTION PROBABILITY | SLB VANILLA PRICE | SLB OPTION PREMIUM | SLB PRICE | EVB COUPON | EVB PRICE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00% | 4.219 | 0.875% | 0.250% | 50% | 99.5% | 0.5% | 100.0% | 1.00% | 100.0% |
| SPT ACHIEVED | 0.75% | 4.230 | 0.875% | 0.250% | 0% | 100.5% | 0.0% | 100.5% | 1.00% | 101.1% |
| SPT MISSED | 1.25% | 4.209 | 0.875% | 0.250% | 100% | 98.4% | 1.1% | 99.5% | 1.00% | 98.9% |
| | | | | | | **AVERAGE PRICE** | | **100.00256%** | **<** | **100.00263%** |

**Table 3.4** Hypothetical pricing for an SLB with convexity and skew. Durations are calculated using Bloomberg YAS and ENELIM 0.375% 27s, calculated 20 Jan 2023

| | MID SPREAD | DURATION | SLB BASE COUPON | SLB STEP | SLB OPTION PROBABILITY | SLB VANILLA PRICE | SLB OPTION PREMIUM | SLB PRICE | EVB COUPON | EVB PRICE |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1.00% | 4.219 | 0.875% | 0.250% | 50% | 99.5% | 0.5% | 100.0% | 1.00% | 100.0% |
| SPT ACHIEVED | 0.75% | 4.230 | 0.875% | 0.250% | 0% | 100.5% | 0.0% | 100.5% | 1.00% | 101.1% |
| SPT MISSED | 1.50% | 4.198 | 0.875% | 0.250% | 100% | 97.4% | 1.1% | 98.4% | 1.00% | 97.9% |
| | | | | | | **AVERAGE PRICE** | | **99.47988%** | **<** | **99.47925%** |

## 3.5 SLBS AS IMPACT INVESTMENTS: DRIVING CHANGE

With the growth of sustainable finance, more and more quantitative metrics are required to gauge how "sustainable" a given investment portfolio is. Fixed income is lagging equities in this regard, perhaps not out of conservatism, but because of the lack of well-grounded theoretical frameworks on how to map bond impact to portfolio metrics. Carbon emissions are a case in point, where basic questions such as: "I own the stock, a 2yr bond, and a 10yr bond in one company. How do I split its carbon footprint around my investments?" simply have no clear answers.

The ability to accrue impact measurements at a portfolio level has practical importance, too, as many jurisdictions are starting to demand these of funds if they want to label themselves (any derivative of) "sustainable."

In this context, there will often be a comparison of SLBs and green bonds in terms of impact. Green bonds (UoP bonds) are 'simple' in the sense that they are dedicated to fund very low emissions projects and/or assets. If an oil company issues a green bond, if we feel certain that the green bond actually funds renewable energy that replaces fossil fuels, then this is a very clear zero carbon footprint investment.[11] In practice, investors generally do not make such assumptions, instead using a benchmark percentage. For example, they may assume the emissions of a green bond are 50% of those of traditional bonds. See "The Forensic Carbon Accountant: green bond carbon footprint", AFII, June 2023, for an in-depth discussion.

Below we explore a theoretical framework for understanding SLBs' relationship to impact, keep in mind that it may be some time, if ever before the full spectrum of SLBs can be classified in a uniform way. See Case 15 for a discussion around the eligibility of SLBs for funds meeting the EU's Article 9 definition, often considered the benchmark for categorising an asset as impactful. As shown in this case, there is simply no consensus around how an SLB should be considered in this context. This is in keeping with many of the case studies in this book: some SLBs are clearly seeking to drive more sustainable behaviour and impact than others.

Note that the following section is light on specific SLB case studies: turn to Chapter 4 for an extended discussion on how to drive impact through setting sustainability performance targets.

[11] A debate can be had around the certainty in a use-of-proceeds bond, with the main two caveats being around fungibility of cash on balance sheet and additionality. The first refers to money going to a use-of-proceeds bond that is not asset-backed. In this case, the proceeds can be seen as quasi-funds for the rest of the capital structure. The second asks whether the use-of-proceeds bond financed something that would have happened anyhow, thus reducing the impact of the investors' money versus the baseline case.

## CASE STUDY 15
## ELIGIBILTY OF SLBS FOR ARTICLE 9-TYPE FUNDS

**RESEARCH: ARE SLBS THE RIGHT SHADE OF GREEN FOR ARTICLE 9 FUNDS?, NORDSIP, MAY 2023**

### SLBS: ARTICLE 9 ELIGIBLE?

In an informal survey of Nordic financial services professionals, NordSIP found that SLBs are not always, by definition, eligible for funds classified as Article 9 under the Sustainable Finance Disclosures Regulation (SFDR). However, some SLBs can, in principle, be appropriate investment tools if they qualify as a "sustainable investment". Nevertheless, there is no consensus on Article 9 eligibility among asset managers.

### REGULATORY PERSPECTIVE

The Article 9 eligibility of SLBs does not have a dedicated regulatory framework. Contrary to green or social bonds, which are Use-of-Proceed (UoP) bonds that ringfence the funds towards a specific set of sustainable projects, SLBs do not provide these assurances.

The confusion caused by this vague regulatory framework led the (national) European Supervisory Authorities (ESAs) to ask the European Commission (EC) whether "General Purpose" bonds (such as SLBs) could be Article 9 eligible, in April 2023.

According to the EC's reply, the focus should be on whether a specific security qualifies as a "sustainable investment". "The definition of sustainable investment set out in Article 2, point (17), SFDR does not prescribe any specific approach to determine the contribution of an investment to environmental or social objectives (...) [and] financial market participants in scope of the SFDR can invest in funding instruments that do not specify the use of proceeds, such as the general equity or debt of an investee company".

Given this guidance, Nordic Financial Services Authorities' (FSAs) feedback was that as long as investors can show that specific SLBs qualify as a "sustainable investment", they can be included in Article 9 funds.

### PERSPECTIVES FOR ASSET MANAGERS

In this context of subjective eligibility, it is not surprising to find a lack of consensus within the asset management community. Some Article 9 funds have invested in SLBs. However, the lack of ringfencing in the use of proceeds of SLBs left some portfolio managers unconvinced that the funds levied through SLB issuance would not be used in a manner inconsistent with the SFDR "do no significant harm" (DNSH) rule.

The view of the Anthropocene Fixed Income Institute (AFII) is that "SLBs should be allowed to be held in Article 9 funds, if they materially contribute sustainability-wise (such as through decarbonisation) at the issuer level. As these are general corporate-purpose financings, the requirements in terms of proving (non)-Principal Adverse Impact (PAI) assessments are likely to be higher for such SLBs. The issuer-level sustainability performance would likely apply to all debt of a given entity with such a material decarbonisation plan, or which a strong SLB can be a marker of. This represents a key distinction from UoP (Use of Proceed) products where the bond only, and not the issuer, is committed to sustainability,"

Furthermore, AFII argued on the occassion of NordSIP's survey: "An SLB where targets are not met should lose their eligibility for Article 9 inclusion, most likely generating forced selling form Article 9 funds."

### 3.5.1 IMPACT: THE SLB AS A SYSTEMIC DRIVER OF COST-OF-CAPITAL

In order to understand the implications of selecting one security over another in terms of ESG impact, a natural question to ask is: what is the fundamental effect on a company if investors buy security X (or not)? From a purely financial perspective, this will be reflected in how an investor changes the company's cost-of-capital. A company with a plentiful supply of financing due to a "good" capital expenditure plan should have a lower cost-of-capital and is more likely to invest in good (or bad) real economy projects than one that is facing a higher cost-of-capital, as illustrated in Figure 3.5.

Investors' impact on cost-of-capital comes directly through this supply channel. This establishes a direct link between the size of supply, the quantity demanded, and the price required to put supply and demand in equilibrium. In practice, a bond with a lower bid when offered to the market will have to offer a higher coupon if it is to be placed.

There is another channel through which investors can have an impact. This is in the secondary market, where investors exchange issuer capital between each other, thereby determining quantity and supply among themselves. This activity does not affect the issuer directly, unless they have to go out and raise capital, in which case the secondary market is used as the baseline for their primary market offering.

This dynamic is essential to understanding the key difference between fixed income and public equities: fixed income securities have a fixed maturity, and as they roll down and mature, they will need to be refinanced through primary market operations which in turn are also dependent on secondary market activity. This means investors can have a powerful influence over issuers' decision-making, including when it comes to sustainability activity.

The difference between the primary market for equities and corporate bonds is illustrated in Figure 3.6, where we see ratios of between 6x to 15x for corporate bond primary market transactions versus public equities. This does not account for other aspects of the bond markets – like those concerning supras, agencies and sovereigns (SSAs) - that can also be important from an impact perspective.

Also important for understanding the difference between primary vs secondary market operations across equities and fixed income is the fallacy that "one's seller is another's buyer." This argument assumes trading is just a secondary market phenomenon. This is patently false, though much more so in fixed income. Company Y may not care if investor A sells bonds to investor B at a certain price. But if investor A does not want to buy company Y's bonds in a primary market offering, company Y will have to increase the offered interest rate on the bond (inversely, lower the price) to entice investor B to replace investor A. That is a baseline

**Figure 3.5** The cost-of-capital see-saw

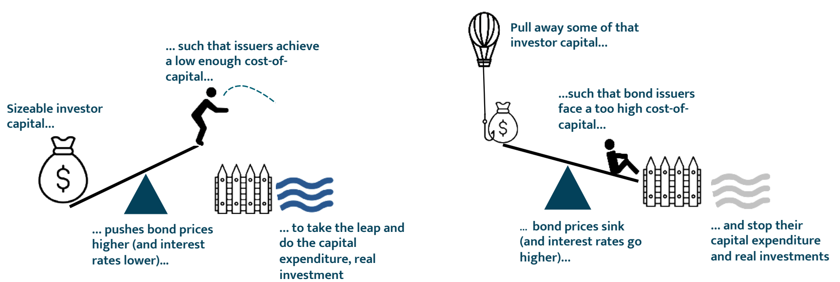
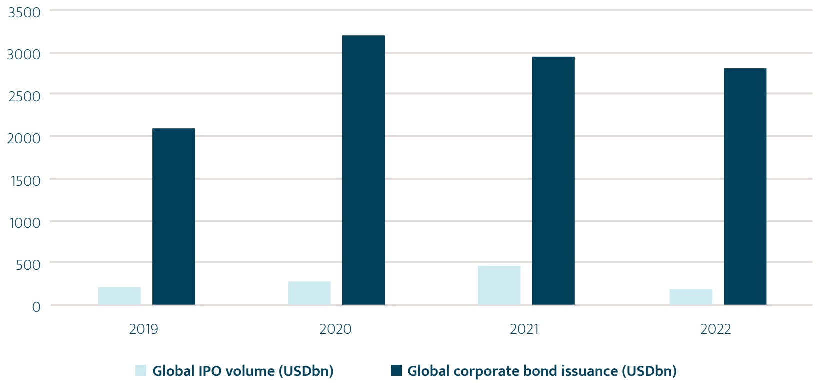


**Figure 3.6** Primary market capital raising by asset class (USDbn)




SOURCE: EY, S&P Global Ratings

cost (higher interest rate) to the company, which will eventually translate into (reduced) investment rates, again as illustrated in Figure 3.5.[12]

### 3.5.2 SLB IMPACT ESTIMATION

The above discussion may seem trivial for the SLB investor; of course, buying an SLB has a cost-of-capital impact on the issuer, it is in the bond prospectus! An investor providing capital for an issuer in an SLB format produces a cost-of-capital effect and impact effect almost by definition. If a company commits to reduce carbon emissions by 1MT $CO_2e$ in an SLB structure, the investor could claim that its %-age investment in the SLB contributed to the same %-age of lower carbon emissions.

But of course, things are more complicated than that. Suppose that the company is quite dirty and emits 100MT $CO_2e$ per annum. The SLB is issued for general financing purposes, and is therefore supporting that 100MT as well as the specific 1MT reduction. So, what is the real impact of the SLB? And what is the (negative) impact of the SLB providing capital for the carbon footprint of the capital structure in its entirety?

**Structural absolute approaches** look to connect every USD1 in a capital structure to every ton of GHG emissions from the issuer. The difficulties calculating this linkage, without a model framework, are obvious. Assume a company emits 100MT $CO_2e$ has a USD1bn equity market capitalisation, and two bonds outstanding – one 5-year bond of USD1bn and one 30-year bond with USD500mn outstanding, plus a partly drawn revolving bank facility of USD300mn: how much does a dollar invested in any one of these securities 'own' in terms of the GHG emissions?

If we had a complete model, in the SLB context, one could imagine the attribution of GHG emissions being calculated on a business-as-usual versus transition basis, with the latter being actualised by the SLB's SPT(s). Say the issuer is expected to have emissions of 75MT if it has transitioned, but 100MT if it has not. One could then re-weight the GHG emissions based on shares of scenario emissions (so, the SLB would be get a footprint based on 75MT and all the other securities based on 100MT), on a normalised basis such that the emissions still summed up to current emissions.

[12] See "Investment and the cost of capital: New evidence from the corporate bond market", Gilchrist, S. and Zakrajsek, E., NBER working paper 13174, 2007. A recent project by Oxford University "Energy Transition Risk and Cost of Capital Project (ETRC)" documents recent changes in cost of capital in terms of green versus dirty companies in the Energy sector.

However, the assumptions required for such an exercise would have to be fairly brave. There are also clear risks of double-counting in the fixed income portfolio context: after all, mixing sovereign, quasi-sovereign and corporate emissions may very well result in the same emissions being counted multiple times.

**Relative (intensity) approaches** look at weighted averages of emissions per unit of something – usually revenues – which obviates the need for structural modelling. In an intensity approach, it does not matter if the issuer places more bonds or if its market capitalisation changes, the investor's 'footprint' remains the same. A drawback with the intensity approach is that the denominator (e.g. revenues) makes the analysis more data dependent, which means that the attribution of emissions can take time to determine and can be influenced by the issuer to some extent.[13] Inflation is another issue: prices and revenues rose more than carbon emissions during 2022-23, and would look like decarbonisation under an intensity approach.

An SLB intensity footprint could, as in the structural absolute approach, be based on target intensity rather than current intensity – potentially probability weighted, which would make the instrument attractive to investors looking to lower the total carbon intensity of their portfolios.

**Non-parametric approaches,** also called "scoring", translate structural or intensity metrics into relative scores. An example is given in the AFII FIONA/ECOBAR framework, see Case study 16, where issuers are scored on a relative basis to their sector peers (1,2,3) and sectors relative to each other (1,2,3). The total score is simply the product of the two (1,2,3,4,6,9). Bonds are then "footprinted" by multiplying their %-contribution to total duration risk in the portfolio multiplied by the issuer score. Green bonds are given a 0 score.

Scoring approaches are flexible and can be adjusted for the strength and ambition of the SLB targets. A very ambitious SLB (with a fairly high option premium), may get a more significant up-notching to their score relative to a non-ambitious one. In the FIONA/ECOBAR framework, for example, a very ambitious SLB may be given a score equivalent to a green bond, i.e. 0.

An important advantage with the non-parametric approach is its relative simplicity in practical situations. From a portfolio manager perspective, easily understanding what score an SLB will get, and how that will affect the portfolio total score, is advantageous in live market situations, such as primary market processes where decisions may need to be made in matter of minutes. It is also a more meaningful metric in terms of return attribution: a portfolio aggregated non-parametric score could be meaningfully correlated with measures of excess returns, for example.

To illustrate the implementation of a non-parametric method for scoring SLBs, consider the following proposed approach from the AFII portfolio strategy team, which leverages the ECOBAR/FIONA framework (see Case 16 for more detail):

- Decide if the SLBs' SPTs are relevant to the strategy. If not, score the SLB as a traditional bond.
- (A): Calculate the total, cumulative possible coupon step payment amount for climate-related KPIs in the SLB structure.
- (B): Decide on the likelihood that the coupon adjustment will occur, with a baseline assumption of 50% (ambitious) and an upper category assumption of 20% ("easy to achieve"). SLBs that target SBTi-aligned SPTs are assigned a 50% factor.

[13] AFII has recently analysed the situation of oil sands revenues of ConocoPhillips as an example of the sensitivities around intensity measures / revenue threshold.

- Calculate the product of (A) and (B); (A) x (B) = (C). Adjust score according to the following scaling:
    - (C) < 0.1 => No change in score
    - 0.1<(C) < 0.25 => score improves to the highest possible for the sector (e.g. a '6' issuer becomes a '3'). If the issuer is already a top performer in the sector, adjust to the next lowest notch (e.g. from a '3' to a '2').
- (C)>0.25 => ECOBAR score of 0
- Greenwashed SLBs obtain a 9 ECOBAR score, similarly to the logic for greenwashed green bonds.

This approach calculates the option value using a rule-of-thumb for step probability, and then decides on the score improvement based on the option value. But it also allows for discretionary judgement to be applied to structures perceived as damaging to the asset class per se.

The disadvantage of this approach is that it is hard to link to some sort of structural value in terms of climate footprint. The advantage is that it gives a clear incentive for investors 'in the trenches' to actually invest in the material impact of SLBs. **If we truly believe that scaling transition finance is make-or-break for the climate, then those bonds that contribute the most to decarbonisation in hard-to-abate sectors should of course be attributed with (at least) as benign a 'footprint' as use-of-proceed bonds that are financing already existing green assets.**

### 3.5.3 IMPACT: DO STEPS CHANGE ISSUER BEHAVIOUR?

A common critique of the SLB market is that from a quantitative standpoint, a relatively small step-up of, for example, 0.25%, on one individual bond represents too small a financial impact to drive any behaviour changes, or in other words "impact". The cost of non-compliance is simply too small relative to capital expenditure or earnings/income potential.

In response to these critiques, consider the following two points. . First, step-ups should be seen in the light of the spread at which the issuer is trading, rather than outright yields. For high-grade issuers, usually having bonds trading inside 100bps, a 25bps step is a substantial proportion of the spread that they are paying for bond finance.

Second, it is  useful to pro-rate the step-up 'cost' across the whole capital structure, rather than view it in isolation. What would the effect be for the issuer if all bonds were replaced with SLB structures and saw such  step-ups? Viewed through this lens, the step-upis clearly more significant.

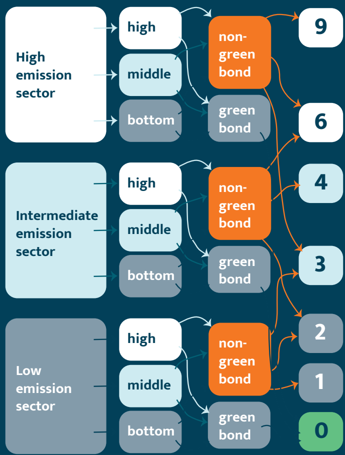
Of course, as we have argued in Chapter 2, one should look for more material financial incentives, to make the benefit of SLBs  more apparent. An interesting alternative approach, tying step sizes to actual earnings, has been suggested in "Do sustainability-linked bonds have a step-up problem?", Reznick et al. (2022).

More work needs to be done to determine what step sizes are reasonable to change issuers' behaviour. However,  proposing that they are irrelevant seems to be overstating the case. When considered against alternative impact-focused investor approaches, such as  unconditional funding with engagement and use-of-proceed bonds, the SLB structure compares favourably.

## CASE STUDY 16

## NON-PARAMETRIC IMPACT MEASUREMENT: ECOBAR/FIONA FRAMEWORK

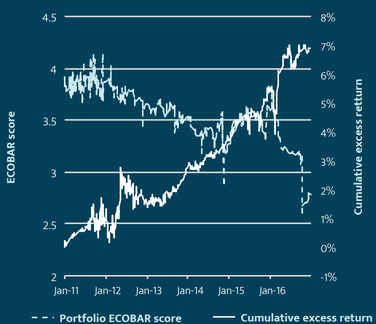
**RESEARCH: CREDIT ALPHA AND $CO_2$ REDUCTION: A PORTFOLIO MANAGER PERSPECTIVE, SSRN, JUL 2017. DECARBONISING ISHARES' LQD ETF, DEC 2022. LOW CARBON CREDIT PERFORMANCE: RATES AND EQUITY SELL-OFF UPDATE, OCT 2021**

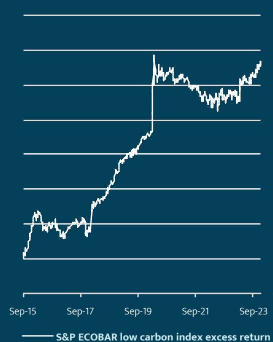



**Case figure 16.1** Illustration of ECOBAR/FIONA scoring system

The ECOBAR and FIONA systems use a 3x3 scoring system based on inter- and intra-sector relative carbon footprints (calculated on an absolute or intensity basis) and can easily be applied to any general ESG input. The relative scores range from 0 to 9, with 9 denoting a high-emitting issuer in a high-emitting sector.

At the individual position level, issuer scores are multiplied by duration/risk contribution weights such that the score can be aggregated in a meaningful way across the portfolio. For an example of this, see the right-hand panel of Case figure 16.2, and an implemented example in a passive index – where high scoring issuers have been held underweight (and analogously for low scoring ones) in the portfolio and compared versus a non-weighted benchmark.




**Case figure 16.2** (left) Non-parametric portfolio score versus excess return on a traded pension fund portfolio, see paper for more detail; (right) Excess return on passive index weighted using non-parametric method. Source: AFII, S&P

## 3.6 SLBS FOR MANAGING HIGH-LEVEL SUSTAINABILITY COMMITMENTS

Whereas the first wave of sustainability-related fixed income investing strategies targeted particular investments, investors are now increasingly seeking to align portfolios with macro sustainability commitments such as net-zero climate targets.

In this context, the key feature of the SLB is the general corporate purpose (GCP) format which means that the conditionalities of the bond structure apply to an issuer in a holistic manner, not just for particular items of capital expenditure or for certain operations.

There are several advantages and disadvantages to the GCP approach. On the positive side, the instrument is **outcome-focused** rather than investment-focused. To make a comparison, should one's fitness regime success be defined as physical fitness (e.g. stamina) – which is an outcome – or the amount of time one spends in the gym (investment-focused)? They are of course fairly correlated: the former seems to make more sense, but the latter is easier to define.

To continue the metaphor, defining a holistic fitness measure is more difficult than looking at 'investments'. Gym visits are easily counted and can be broken down into great detail in terms of the exercises performed and number of repetitions. All of this can be reported and verified, and we know that each of them does some good. Compare this to trying, first, to define what "fitness" is and then, second, measuring improvements to this state. We discuss metrics and triggers at length in Chapter 4, but can already note that **outcomes take longer to effectuate and corroborate. This is a fundamental reason why many SLBs (should) have performance targets towards the latter half of their tenor.** Case 11 presented an illustration of this, where green bond issuance – everything else being equal – came in shorter-dated form than the SLB.

Still, the outcome-focused approach could be best suited to incentivise change, especially among those where change is most needed. Our gym visitor's fitness is probably better served by their stopping smoking two packs a day than going from a two-times-a-week to a three-times-a-week gym regime. There are additional dynamics to contend with as well: is the gym visitor more likely to indulge in vices, if they are visiting the gym more often? An outcomes-focused target, like: "you should be able to run 1 kilometre in 5 minutes" may make the gym visitor more efficient in their efforts to improve fitness (reduce smoking and increase exercise), and less hung up on counting gym visits. Arguably, activities with large negative side effects, such as puffing smoke, are better curtailed by holistic and outcome-focused instruments.

A practical example of this is provided in Case 14 earlier in the chapter where we study the potential for an SLB issuance for the Japanese sovereign. The argument of this research is that capital expenditure in green/transition projects (countable gym visits) is good, and can be well complemented by steering the total emission level of the sovereign (getting fit to be able to run the mile at a decent pace). In other words, the SLB is a strong proposition for managing the high-level sustainability commitment.

# CASE STUDY 17

## PROPOSING AMBITIOUS SLB TARGETS: BHP, ANGLO AMERICAN

**RESEARCH: BHP: THINK BIG WITH AN SLB, FEB 2023**

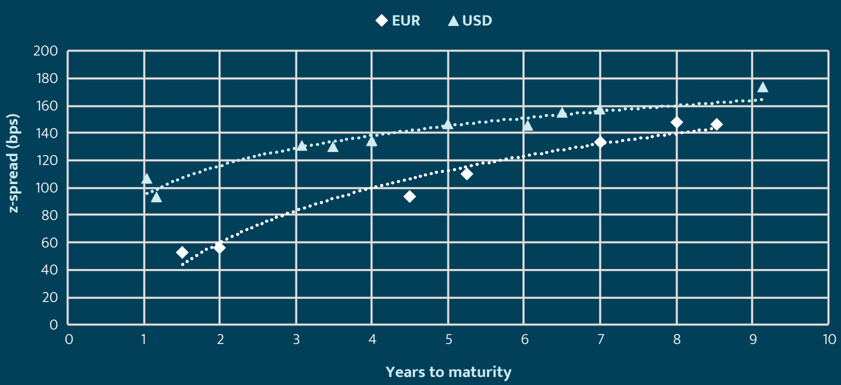
**BOND: AALLN EUR4.75% 09/32 (XS2536431617)**

BHP is one of the big global mining companies, and as such plays an important role in the energy transition, both as a source of emissions and as a provider of critical raw materials for net-zero technology. AFII proposes an SLB structure that would involve targets on Scope 1, 2 and 3 emissions as well as a 100% reduction in thermal coal production, in line with the company's earlier commitments.

Although the company has clearly stated emissions reduction targets, there are concerns regarding how it plans to effectively align its capital expenditures with its decarbonisation plan. An ambitious SLB can alleviate such concerns by aligning the company's capital with specific targets, thereby providing bond investors with a hedge against potential shifts in the company's strategy. There is precedent for SLBs in the mining sector. In September 2022, Anglo American issued a EUR745mn SLB (XS2536431617) with three KPIs; one linked to direct emissions, one to water usage, and one to local job creation (see Case table 17.1).

| KPI | BASE DATE | BASE VALUE | SPT | TARGET DATE |
|---|---|---|---|---|
| Operational emissions (Scope 1+2), Absolute ($MtCO_2e$) | 2020 | 16.2 | -30% | 2030 |
| Scope 3 emissions, Absolute ($MtCO_2e$) | 2020 | 415.7 | -23% | 2030 |
| Thermal coal output (Mt) | 2022 | 18 | 0 | 2030 |

**Case table 17.1** Example of KPIs and targets for a hypothetical BHP SLB. Source: Bloomberg, AFII




**Case figure 17.2** AALLN bond curve in EUR and USD, including SLB. Pricing as of March 2024. Source: Bloomberg, AFII

Another perspective to consider is that the SLB targets will be applicable across all bonds (and other capital securities), not only to the SLBs themselves.

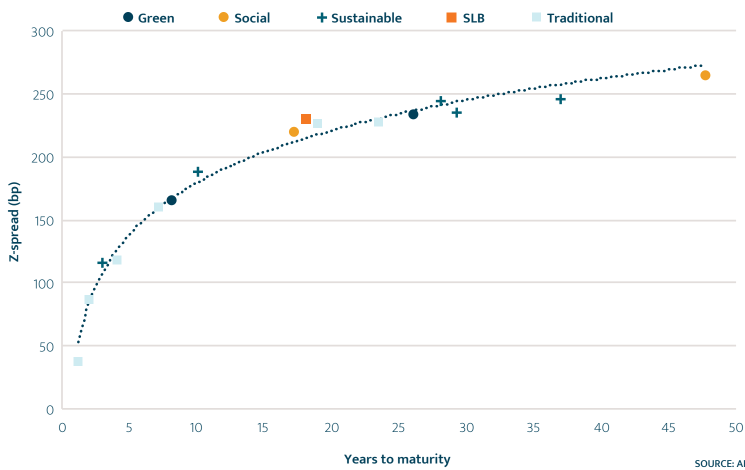
Indeed, use-of-proceed bonds and SLBs are highly complementary, and a number of prominent issuers use a combination of SLBs and GSSS bonds. See Figure 3.8, which illustrates the curve of sovereign issuer Chile, for an example. In the case of a bond-only issuer, the improved behaviour by the issuer that is hypothetically driven by a single SLB actually accrues to the benefit of all other bond holders as well. This is sometimes referred to as a 'halo' effect.

The halo effect means that the sustainability benefits driven by the SLB also accrue to other parts of the capital structure, for example to bank lending and equity shareholdings. Hypothetically, an equity investor trying to ascertain a company's transition plan is likely to prefer a company where such transition plans are committed to contractually (through the SLB bond contract) compared to one where the plans are only 'soft' committed. There is a transition-halo effect on the whole capital structure from the issuance of the SLB.

As the SLB market grows, a growing portion of equity market cap will come under the umbrella of SLB conditionalities. Table 3.2 presents the largest companies by market capitalisation with benchmark SLBs outstanding. The sample covers USD40bn in terms of benchmark issuance, and almost USD1.8trn in market capitalisation, illustrating the amplification potential of SLB conditionality. Further research will be required to cover SLB impact on private companies as well as other types of debt.

It is not always the case that equity and fixed income investors in the same capital structure are aligned. If SLB investors in step-up structures are getting a hedge on poor sustainability performance, obviously equity investors that do not have this benefit will resist the pay-out of such a hedge (as it reduces the dividend potential). We illustrate this tension in the case of Sembcorp (Case 18). However, this is an ex-post rather than ex-ante perspective: as a shareholder, you may want your "company" to win in court in almost any case (ex-post), but you also want it to adhere to laws (ex-ante). The SLB/equity holder dynamic should operate in a similar way.

**Figure 3.8** Chile bond curve. See "Chile sustainability-linked bond: optionality analysis"




SOURCE: AFII, 5 Apr 2022

A second lesson from the Sembcorp case is the importance of **target perimeters**, or more specifically how one defines the capital structure to which the SLB targets apply. What happens in the case of divestments or acquisitions of investment activities? This remains an area under development and subject to market stakeholder discussions: we elaborate on some more cases in Chapter 4.

Managing commitments through SLBs may be difficult on an individual basis, but as we see more and more structures, a sectoral approach can be taken, and then targeted toward particular themes using sector peers' targets as benchmarks. In Table 3.3, we document the SLBs that have come out of AFII's deforestation exposure portfolio (RDCP).[14] As can be seen, most SPTs are related to carbon emissions and climate rather than deforestation. It may be that investors start asking for more nature-loss related SPTs rather than simple Scope 1 + 2 emissions-based SPT going forward, with a good example provided by the Ahold case study in Case 12 in the first part of this chapter. Consistently asking for relevant targets across a sector may seem like menial work, but the potential 'win' in changing a sector could be very well justified from an impact perspective.

**Table 3.2** Benchmark SLB issuers with public equity traded and market cap >USD40bn as of March 2024. Source: AFII, Bloomberg

| PARENT EQUITY | EQUITY TICKER | MARKET CAP MARCH-2024, USDBN) | BENCHMARK SLB ISSUED (USDBN) |
|---|---|---|---|
| L'OREAL | OR FP | 259,776 | 1,148 |
| NOVARTIS | NOVN SW | 220,691 | 500 |
| CHINA CONSTRUCTION BANK | 939 HK | 156,019 | 901 |
| SCHNEIDER ELECTRIC | SU FP | 134,109 | 500 |
| S&P GLOBAL | SPGI US | 132,805 | 423 |
| SANOFI | SAN FP | 121,473 | 500 |
| EATON CORP | ETN US | 119,128 | 391 |
| ANALOG DEVICES | ADI US | 96,801 | 500 |
| ENBRIDGE | ENB CN | 75,495 | 1,615 |
| ENEL | ENEL IM | 67,873 | 25,147 |
| ENI | ENI IM | 53,325 | 2,050 |
| DHL GROUP | DHL GR | 52,727 | 1,250 |
| HOLCIM | HOLN SW | 50,837 | 750 |
| WESFARMERS | WES AU | 49,965 | 597 |
| JOHNSON CONTROLS INTERNATIONAL | JCI US | 43,063 | 307 |
| PERNOD RICARD | RI FP | 42,143 | 1,700 |
| FOMENTO ECONOMICO MEXICA | FEMSAUBD MM | 41,469 | 850 |
| EQT AB | EQT SS | 41,064 | 1,600 |

**Table 3.3** SLBs in the food sector, with potential exposure to deforestation (AFII RDCP)

| COMPANY NAME | ISIN | KPIS |
|---|---|---|
| KLABIN SA - UNIT | US49836AAB08, US49835LAB71 | WATER CONSUMPTION, WASTE REUSE, REINTRODUCTION AND/OR REINFORCEMENT OF WILD SPECIES INTO THE ECOSYSTEM |
| LOUIS DREYFUS CO BV | XS2531571946 | $CO_2$ EMISSIONS, ELECTRICITY CONSUMPTION, WATER USAGE, SOLID WASTE |
| JBS SA | US72147KAF57, USL5S59NAA30, US72147KAF57 | SCOPE 1 AND 2 GHG EMISSIONS |
| TESCO PLC | XS2289877941, XS2403381069 | SCOPE 1 AND 2 GHG EMISSIONS |
| KONINKLIJKE AHOLD | XS2317288301, | |
| DELHAIZE N | XS2780025511 | SCOPE 1 AND 2 GHG EMISSIONS, FOOD WASTE |
| GENERAL MILLS INC | US370334CQ51 | SCOPE 1 AND 2 GHG EMISSIONS |
| CARREFOUR SA | FR001400D0F9, FR0014009DZ6, FR0014009E07 | SCOPE 1 AND 2 GHG EMISSIONS, PACKAGING AVOIDED, FOOD WASTE |

[14] Original research in "RDCP: Deforestation exposure in liquid credit portfolios", AFII, Dec 2023.

## CASE STUDY 18
## SLB HALO EFFECT GOING THE WRONG WAY: SEMBCORP

**RESEARCH:** SEMBCORP: "CARBON FOOTPRINT ARBITRAGE OF A LIFETIME", NOV 2022

**BOND:** SCISP SGD2.66% 04/32 (SGXF52048042), SCISP SGD3.735% 04/29 (SGXF59468540)

**In a letter to shareholders, Sembcorp clearly spelled out that the failure to sell an Indian coal plant in a standard way necessitated financial engineering in order to avoid paying SLB step-ups.**

*"Given the limited availability of funding for coal-related projects due to ESG considerations of financial institutions globally, bidders were given the option of vendor financing via a deferred payment note, in addition to the options of using an all-cash bid or a combination of the two."*

*"The option of retaining SEIL was considered, however, this could lead to a step-up in interest costs for SCI's sustainability-linked financing instruments. In particular, the interest rates relating to SCI's sustainability-linked bonds, totalling S$975 million issued in October 2021 and April 2022, will be subject to a step-up margin of 0.25 per cent. from the first interest payment date on or after 1 April 2026 if the stated Sustainability Performance Target is not achieved."*

Sembcorp letter to shareholders

| BOND | ISIN | TENOR | ISSUED | VOLUME | CHARACTERISTIC |
|---|---|---|---|---|---|
| SCISP 2.45 06/31 | SGXF23837739 | 10YR | JUN-2021 | SGD400M | GREEN BOND, THE FIRST CERTIFIED CLIMATE BOND UNDER THE CLIMATE BOND STANDARD BY A SINGAPORE-BASED ENERGY COMPANY |
| SCISP 2.66 04/32 | SGXF52048042 | 10.5YR | SEP-2021 | SGD675M | SLB WITH SPTS 1. GHG EMISSIONS INTENSITY (SCOPE 1 + 2); 2. GHG ABSOLUTE EMISSIONS (SCOPE 1 + 2); AND 3. GROSS INSTALLED RENEWABLE ENERGY CAPACITY. STEP-UP MARGIN OF 25BPS FROM APRIL 2026 IF THE SPT OF GHG EMISSIONS INTENSITY REDUCTION TO 0.40 $TCO_2E$/MWH BY DEC-2025. 2020 GHG EMISSIONS INTENSITY WAS 0.54 $TCO_2E$/MWH. THE SLB FRAMEWORK INDICATES THAT SEMBCORP WOULD REVISE ITS SPT IN CASE OF CHANGE OF PARAMETER |
| SCISP 3.735 04/29 | SGXF59468540 | 7YR | APR-2022 | SGD300M | SLB, 25BPS COUPON STEP-UP BASED ON GHG EMISSIONS INTENSITY REACHING 0.40 $TCO_2E$/MWH ALSO BY DEC-2025. 2020 GHG EMISSIONS INTENSITY WAS 0.54 $TCO_2E$/MWH. THE SLB FRAMEWORK INDICATES THAT SEMBCORP WOULD REVISE ITS SPT IN CASE OF CHANGE OF PARAMETER |

**Case table 18.1** Sembcorp green/sustainability-linked bonds. Total debt in SCISP amounts to approximately SGD4bn. Source: Bloomberg, AFII, company documentation

## 3.7 FINANCIAL INCENTIVES FOR TRANSPARENCY

Another market halo effect of SLBs, beyond driving high-level sustainability commitments, is the structure's potential to drive transparency.

SLBs can be seen as a derivative of the issuer's KPIs: the financial value of the SLB is directly related to how KPIs evolve. This gives SLB investors a unique position within the capital structure to request clear, accurate, and timely reporting on KPIs. Without the proper data to hand, valuation (as we will show in the pricing chapters) becomes more difficult. It is also in the interest of issuers as a collective to provide such data: if investors do not perceive processes around KPI data to be transparent, they will factor in a model premium when pricing SLBs, thus reducing the potential cost-of-capital savings the issuers can make from using SLBs in the first place.

If an investor has sufficient reliable data to say that there is a 50% chance that an issuer will hit its SPT, it will be able to provide funding at a lower cost-of-capital. If it does not have sufficient data, it will – driven by a fiduciary point of view – likely assume that the probability is very high, or even 100%, that an issuer will hit its SPT and avoid a step-up. As a result, the investor will be unable to provide capital at a lower cost to the issuer. **This underlines why SLBs should be a driving factor in better data provisioning.**

To exemplify, imagine an investor that seeks to purchase an SLB where a coupon-step worth 50 cents in optionality is determined on a future coin-flip, as determined by direct observation. This would imply, using the 50/50 probability on the coin-flip, that the coupon step-up is worth USD1 in present value terms. The investor can in this case pay the 50bps option premium with no discount due, as there is neither **model uncertainty** (if they know how to do present-value calculations), **statistical uncertainty** nor **observation uncertainty.**

However, suppose that the issuer of the SLB is suspected (by the investors) to be able to flip the coin twice and therefore pick-and-choose what evidence to produce to the investor. This means that the investor rationally can only assume a 25% probability of a step-up happening, and consequently – if it is rational – only pay 25bps option premium. This **observational uncertainty** means that issuers that are completely fair (just using one coin) cannot obtain what would be the fair option premium and lower cost-of-capital.

Indeed, from a game-theory point of view, it could be expected that issuers that are able to manipulate the observations would be more likely to come to the SLB markets, a classic case of "adverse selection." This is a very negative assumption, however, and predicated on investors being hopelessly naïve.

So, what is the actual state of play? Given that not a lot of optionality has been priced into the SLB market (see Chapter 2 on current SLB market pricing), it is extremely difficult to tell how much of a role observation uncertainty plays. Having said that, we provide two case studies (Case 19 and Case 20) where information around observations is non-satisfactory, and whereby the issuer could benefit from improving it, in order to price deals more attractively.

## CASE STUDY 19
## SEEKING MORE TRANSPARENCY THROUGH SLBS: JBS

**RESEARCH:** THE FORENSIC CARBON ACCOUNTANT: JBS SLB, SEPT 2023

**BOND:** JBSSBZ USD3.625% 01/32 (US46590XAU00)

**JBS, a Brazilian meat producer, is a company with significant sustainability concerns linked to deforestation. In September 2023, it was seeking a US stock listing, which is raising scrutiny both of its environmental commitments and corporate governance.**

**JBS had issued three SLBs, with a coupon step-up linked to emissions intensity commitments. We analysed JBS' emissions reporting to understand the implications for bondholders, and arrived at the following conclusions:**

- **JBS has reported its 2019 Scope 1 + 2 emissions (at least) four times, with each being different (see Figure 1). JBS acknowledges the adjustments but offers no explanation. In our view, this shows minimal commitment to transparency around sustainability performance, which is essential to investor dialogue.**
- **SLB investors have an opportunity to request clarification from JBS. SLBs derive their value from issuer KPIs, here Scope 1 + 2 emissions intensity, and so the burden of transparency on JBS is higher. SLB investors can demand explanation and scrutiny on restatements.**
- **Several of the lead arrangers of JBS' recent bonds have deforestation policies that, according to our analysis, would make them unable to accept business from JBS. This raises concerns about JBS' ability to maintain banking relationships, which may make it more difficult to access finance in the future.**


**Case figure 19.1** JBS Scope 1 + 2 emissions. Source: JBS

## CASE STUDY 20
SEEKING MORE TRANSPARENCY THROUGH SLBS: NOBIAN

**RESEARCH:** NOBIAN SLB: A LOT OF HOT AIR?; SLB TRIGGERS: WHAT NEXT IF NOBIAN OR PPC MISS THEIR TARGETS, MAY 2023

**BOND:** NOHOLB EUR3.625% 07/26 (XS2358383466)

Nobian (ticker NOHOLB), a privately owned European chemical company, issued a sustainability report in 2022 showing a significant drop in emissions. The company avoided paying a coupon step-up to its SLB investors. However, it was unclear how this emissions reduction was achieved.

Nobian's report includes 2022 KPI data relevant for NOHOLB EUR3.625 26s. The SLB includes two KPIs with targets at the end of 2022: Scope 1 + 2 absolute emissions, and percentage of energy from renewable sources. Based on historical data, the first seemed hard to achieve.

Emissions reportedly reduced by 25% year-on-year (see Case figure 20.1), far in excess of the targeted -4% in two years. Detailed analysis of the sustainability report suggested possible creative emissions accounting with regards to steam generated from Municipal Waste Incineration (MWI). This led us to the following best practice recommendations:

- **EMISSIONS REPORTING NEEDS TO BE COMPLETE** If MWI is used to reduce Scope 2 emissions without a corresponding reclassification into Scope 3, this represents a carbon footprint arbitrage.
- **SLBS REFERENCING ONLY SCOPE 1 + 2 EMISSIONS ARE EXPOSED TO RECLASSIFICATION RISK** Baseline restatements should protect from policy changes, but if Scope 3 emissions are not included from the outset, investors are at risk from inventive business accounting.
- **WHERE GHG ACCOUNTING GUIDANCE IS UNCLEAR,** as it the case with MWI, care should be taken to ensure emissions reporting considers the ultimate usage of that data. Auditors should take a conservative approach to classification, especially when there are associated SLBs referencing that data.

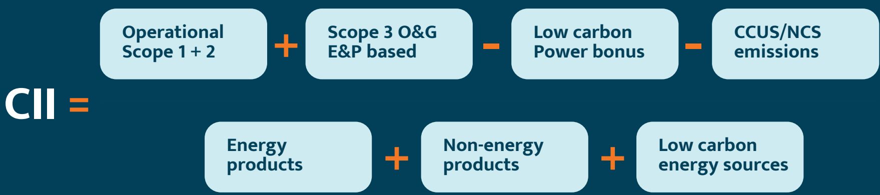

**Case figure 20.1** Nobian Scope 1 + Scope 2 emissions. Source: Nobian, AFII

# CASE STUDY 21
## COMPLEXITY OF SINGLE SPTS: REPSOL

**ARTICLE:** AN OPTION PRICING APPROACH FOR SUSTAINABILITY-LINKED BONDS, NOV 2022

**BOND:** REPSM EUR0.375% 07/29 (XS2361358299), REPSM EUR0.875% 07/33 (XS2361358539)

**In 2021, Repsol, a Spanish oil and gas company, issued the sector's first SLB with carbon intensity reduction targets for 2025 (-12% for the 2029 bonds, step +25bps) and 2030 (-25% for the 2033 bonds, step +37.5bps). The carbon-intensity indicator (CII) was defined according to the following formula:**




**Case figure 21.1** The carbon-intensity indicator (CII)

**On the positive side, and very importantly, the inclusion of Scope 3 emissions in the CII metric should be standard for oil and gas and Repsol addresses this.**

**However, question marks arise around other intensity metrics. In the nominator, "Low Carbon Power Bonus" is subtracted, and the metric includes replacing coal with fossil gas, which can generate emissions reductions in the short term (unless there are methane leakages) but result in longer-term lock-in effects.**

**In the denominator, "Non-energy products" will reduce the CII, and refer mostly to petrochemical products (plastics). As the company expresses it: "Chemical products are considered carbon sinks." It may be risky for managers to make that claim to end-investors.**

**Model uncertainty** arises when it is too hard or too complicated to understand the model used to determine whether an SPT is achieved or not. Case 21 illustrates a KPI by an oil and gas company[15] where a KPI necessitated the aggregation of seven different parameters. Clearly, this would require more of a discount on the option premium due to uncertainty than if there was a single observable data point to determine SPT achievement. Keepings things simple should enable more of the option premium to be realised.

Finally, **statistical uncertainty** arises when the investor is not certain about the probability distribution of data going into the SPT. In the example of rolling a die, we know that the data-generating process is a uniform distribution such that we have no statistical uncertainty.

But in real life settings, picking the right distribution might be trickier. For example, going back to the Japanese sovereign structure in Case 14, there is a step-down option fairly far out-of-the-money – the bond will step down if emissions cuts are significantly bigger than what is currently projected. The bond is priced using an assumption of a normal distribution, but what if actual emissions trajectories have large right-hand tails (high probabilities for very steep reductions), under a hypothesis of technological advances? Then the option is closer to the money and has a higher (for the investor, less positive) value.

Having said this, the biggest driver for most robust SLBs is likely to be the expected means of statistical distributions rather than their shape. And expected means are often relatively close to each other irrespective of (similar) distributions.

### 3.7.1 SLB INVESTORS TO AUDIT SUSTAINABILITY TARGET DATA

One of the crucial features of an SLB is that investors stand to gain financially from disproving claims made by the issuer that sustainability targets have been met.

This would mean that they could pursue legal claims to cover the economic loss: indeed, it would be their fiduciary duty to do so, as they look to maximise economic returns for their stakeholders. If the investor's investment is worth USD100mn and there is a 25bps step-up on the table, it would be rational and indeed its fiduciary duty to pursue the claim for the USD250k per year, and, depending on its belief in success, the associated legal costs. Of course, if there is a consortium of investors able to bring a class-action lawsuit, then the economics as well as human resource allocation to make such a claim would become even more efficient.

This incentive/duty to pursue robust validation of sustainability performance is important in the context of the broader category of GSSS bonds. As illustrated in Table 3.4, the incentives around the SLB and calling out a potential sustainability failure are much more balanced in the SLB case compared to the GSSS case.

Consider an example where a gas production company is looking to decarbonise its production by applying carbon capture storage technology. How would investors react upon finding that, say, the storage facilities failed to keep the $CO_2$ from leaking back into the atmosphere? An SLB investor would push hard for evidence if this were the case, as they would stand to be compensated in terms of higher coupons.

The investor in a use-of-proceeds bond would face a much more challenging situation. From its perspective, this outcome is simply a failure. If it becomes known to the market that its green bond investment, which financed the carbon capture storage facility, is failing and it becomes a forced seller, it will likely crystalise a loss. If it goes public with its inquiries – which would be a public good – then it risks suffering even steeper price falls on its bonds.[16]

[15] To repeat the introduction, this particular case from 2021 should be seen as an illustration of some of the features of the market in its earliest days, and not as a specific critique of the deal itself.

[16] To be clear, the same would actually be the case for a GCP vanilla bond investor. Arguably, regulation would then have to come into play, but at the current juncture, it is not sure that even governments should be relied upon to mitigate climate destructive emissions.

The issuer, on its side, would actively be in breach of its commitments or signalled intentions if the facility failed in this way. This in turn would likely curtail its access to the GSSS bond market. In the worst case, it could affect all its securities, as breach of investor commitments tends to affect the general perception of an issuer's governance.[17]

In the SLB case, the downside of failing on an ambitious target should be seen as a failure, but an acceptable one. A car manufacturer will fail on launching a particular new model, and investors may not be particularly happy about it, but they have been made aware of, and should be cognisant of, such risks. The same should apply to sustainability commitments: it is not an easy game.

Finally, as indicated in Table 3.4, other stakeholders such as bank structurers appear to run a significantly lower risk of reputational disruption in the SLB case relative to the UoP format. Banks may very well write long disclosures around not taking any legal responsibility for a GSSS bond's actual green effects (see Case 22), but from a marketplace perspective, they will be judged on the basis of how many greenwashed deals they bring to market, in the same way they are when bringing deals that disproportionately underperform (even if fully disclosing risks and no liability in prospectuses).

## 3.8 INTEROPERABILITY

One oft-forgotten driver of the green bond market is the technical similarity between green bonds and traditional bonds. From an operational standpoint, in many portfolio systems, green- and non-green bonds are indistinguishable from each other. We can say they have high "interoperability."

SLBs are slightly more complex instruments than green bonds because of the inclusion of a variable coupon rate. From a technical perspective, this feature is usually already incorporated into portfolio risk management systems due to other instruments, such as hybrids and bank capital instruments, also having variable coupon rates. This means the technical steps necessary to understand SLBs are straightforward, and certainly easier than if the sustainability-linked options were stripped out and traded separately.[18]

As can be seen in the previous case studies in this chapter, there are plenty of similarities between SLBs and traditional bonds. Indeed, when it comes to a step-up SLB, the non-stepped version of the bond is structurally identical to a vanilla bond.

**Table 3.4** Use-of-Proceed versus general corporate purpose bonds/SLBs: effects of failing to meet green targets

| EFFECTS OF ANNOUNCING A BOND AS FAILING ON SUSTAINABILITY INTENTIONALITY | GREEN BOND FAILING ON USE-OF-PROCEEDS TARGETS | SLB FAILING ON GCP TARGETS |
|---|---|---|
| INVESTOR | FINANCIAL LOSSES IF FORCED SELLING OF GREENWASHED BONDS | FINANCIALLY HEDGED THROUGH COUPON STEPS |
| ISSUER | REPUTATIONAL RISK, LOSS OF ACCESS TO GSSS MARKET FOR INDIVIDUAL ISSUERS | FINANCIAL LOSS BUT CONTINUED ACCESS TO SLB MARKET |
| BANK/STRUCTURER | REPUTATIONAL RISK OF MIS-MARKETING DEALS | NEUTRAL: DELIVERING A PRODUCT THAT DOES WHAT IT SAYS |

[17] In the case of Abengoa, the first green bond issuer in the HY market, the confluence between GSSS bond issues and the rest of the capital structure became very apparent.

[18] There has been a discussion historically among some sovereign issuers to strip out the 'green' from their green bonds and trade this separately. The investor feedback on such proposals, essentially putting a financial value to a non-pecuniary feature, has been lukewarm to say the least, see e.g. "Danish DMO advances strippable green bonds", GlobalCapital, 5 Dec 2019.

## CASE STUDY 22
ASSURANCES OF GREEN-NESS IN A GSSS DEAL

**BOND: PIFKSA USD5% 10/27 (XS2542162321), PIFKSA USD5.25% 10/32 (XS2542162248)**

*"As such, no assurance is or can be given by the Issuer, the Guarantor, any other member of the Group, the Arrangers, any Dealer or any other person to investors that (a) the use of proceeds of any Green Bonds, or the business or projects funded thereby, will satisfy, whether in whole or in part any future legislative or regulatory requirements, or any present or future investor expectations or requirements with respect to investment criteria or guidelines with which any investor or its investments are required to comply under its own by-laws or other governing rules or investment portfolio mandates; (b) any Notes will comply with any future standards or requirements regarding any "green" or other equivalently-labelled performance objectives and, accordingly, the status of any Notes as being "green" (or equivalent) could be withdrawn at any time; (c) any adverse environmental and/or other impacts will not occur during the implementation of any projects or uses the subject of, or related to, any Eligible Green Projects; or (d) any event with an adverse environmental or other connotation (such as, for example, the acquisition by the Fund of a company that is not aligned with environmental, social and governance values) will not occur during the life of any Green Bond, which event may affect the value of such Green Bonds, and/or have adverse consequences for certain investors in such Green Bond."*

Offering Circular, GACI First Investment Company guaranteed by the Public Investment Fund, 27 Sep 2022

## CASE STUDY 23
SLB OPERATIONAL CONSIDERATIONS: SLBS AS ECB COLLATERAL

**PRESS RELEASE: ECB TO ACCEPT SUSTAINABILITY-LINKED BONDS AS COLLATERAL, SEPTEMBER 2020**

- Bonds with coupons linked to sustainability performance targets to become eligible as central bank collateral
- Potential eligibility also for asset purchases under the APP and the PEPP subject to compliance with programme-specific eligibility criteria
- Decision applicable from 1 January 2021

The European Central Bank (ECB) has decided that bonds with coupon structures linked to certain sustainability performance targets will become eligible as collateral for Eurosystem credit operations and also for Eurosystem outright purchases for monetary policy purposes, provided they comply with all other eligibility criteria.

The coupons must be linked to a performance target referring to one or more of the environmental objectives set out in the EU Taxonomy Regulation and/or to one or more of the United Nations Sustainable Development Goals relating to climate change or environmental degradation. This further broadens the universe of Eurosystem-eligible marketable assets and signals the Eurosystem's support for innovation in the area of sustainable finance.

Non-marketable assets with comparable coupon structures are already eligible. The decision aligns the treatment of marketable and non-marketable collateral assets with such coupon structures.

Bonds play a special role in the financial system as they are usually the best instruments for raising a large amount of money cheaply and in a short time. The SLB structure, being interoperable with traditional bond instruments, can be used for this kind of expeditious capital raising. This may be an especially important quality in some currently illiquid parts of the investment spectrum, such as public/private co-financing vehicles, as discussed in Chapter 6.

For investors, the liquidity dimension is mostly a secondary market concern: is an SLB as liquid to sell in the secondary market as a traditional bond?[19] Again, interoperability is crucial: it means that fundamentally, the SLB should be no worse than the equivalent vanilla bond in terms of demand. If we have nine general investors that buy all types of bonds as long as they have the same risk-return characteristics, and one that only buys labelled bonds, it means that there are ten potential buyers for the SLB and only nine for the traditional equivalent bond.

**A few technical factors could alter the liquidity dynamics of SLBs, with the biggest one being their inclusion in indices.**[20] In terms of indices specifically designed for SLBs, so far – to our knowledge – FTSE's[21] Global SLBO+ and subfamily is the only index designed purely for SLB inclusion. The index uses ICMA principle alignment and certain size criteria to determine which bonds are included.

A broader index question for SLBs is whether they are included in mainstream indices or not. Similarly to green bonds, most mainstream indices are including SLBs. For example, the BlackRock iShares J.P. Morgan EM Corporate Bond ETF (CEMB US), when sampled in March 2024, held between 1.33% and 1.53% of its net asset value in sustainability-linked instruments, according to Bloomberg data. Finally, regulators' treatment of SLBs is also likely to drive index inclusion (or exclusion): in Case 22 this is discussed in more detail in the European Union context.

### 3.8.1 ACCOUNTING TREATMENT

Accounting guidance offers three potential classifications for debt securities: Held to Maturity (HTM), Available for Sale (AFS), and trading. The classification is important as each has its own accounting treatment and related disclosure standards.[22] AFS, sometimes referred to as 'fair-valued', requires continuous re-valuation of the asset, which can create undesirable income volatility. HTM allows assets to be carried at par, unless impaired via a credit review process, which does not depend on market prices.

SLB structures can present complications for HTM classifications, due to the step-up coupon. It may be possible to treat the step-up coupon as an embedded derivative, and have it accounted for separately, or the coupon may be sufficiently complicated to require re-classification of the entire asset.[23]

The accounting treatment of assets can vary by investor and depend on local regulation and individual interpretation of guidance. There can be no SLB structure that guarantees a certain classification. Anecdotally, some HTM investors are unwilling to buy SLBs due to complications around the accounting treatment. It is reasonable to believe that effectively removing the coupon step, by converting it into an exogenous payment to a charity or carbon offset provider, would simplify the situation, which seems to be the case in Japan, as discussed further in Chapter 4 on alternative coupon-steps.

[18] We prefer to view secondary market liquidity as asymmetrical and to differentiate between bid side and offer side liquidity. Bid-side liquidity, i.e. how easy it is for an investor to sell a bond, is the most important in terms of risk-management and also has important effects on (lower) volatility for labelled bonds. Offer-side liquidity is the ease-of-buying more bonds in the secondary market. This type of liquidity is more easily replaceable by using derivatives, by focusing on sourcing bonds in the primary market and is unlikely to generate more acute situations for most investors.

[20] "Steering a Ship in Illiquid Waters: Active Management of Passive Funds ", Koont, N., Ma, Y., Pastor, L. and Zeng, Y., 2023. Available at SSRN.

[21] "FTSE Russell acquired Citi's BIG index family in 2017.

[22] "3.3 Classification of debt securities", PWC, accessed 4 May 2023.

[23] See 13.11.11.1 of "Life Sciences Industry Accounting Guide", Deloitte, Mar 2023.

04

# SETTING SUSTAINABILITY PERFORMANCE TARGETS

# 04 SETTING SUSTAINABILITY PERFORMANCE TARGETS

## SECTIONS



## CASE STUDIES

"In order for investors to trade and risk-manage SLBs in their portfolios, it is imperative to understand the mechanics of the targets"

## 4.1 OVERVIEW

Sustainability performance targets (SPTs) are integral to the SLB value proposition and for stimulating real-world climate and environmental action.

For the investor, SPTs are important from both a valuation and impact perspective. For valuation purposes, the investor needs to understand the design and the metrics of the targets in order to understand whether coupon steps will occur or not. For impact purposes, the targets need to align with the actual impact strategy of the investor's portfolio. As discussed in the previous chapter, one way to set meaningful SPTs is for investors to do a reverse enquiry, i.e. define targets that they would like issuers to set for themselves which would increase impact or improve sustainability metrics in their portfolios.

From the issuer standpoint, SPTs act as incentives to improve sustainability performance – since achieving them means avoiding the penalty of a step-up rate or reaping the benefits of a step-down. However, the issuer needs to ensure that while these targets are aligned with its strategy, they are not also too restrictive or prescriptive.

This suggests that investors and issuers should confer on what target(s) should be put into the SLB structure: in the end, an SLB transaction will not happen if there is not mutual agreement on the targets or other key structural features. And in order for investors to trade and risk-manage SLBs in their portfolios, it is imperative to understand the mechanics of the targets and what happens if they are achieved or missed.

An example of a situation in which investors could have played an important role influencing the decarbonisation and transition of a high-emitting entity through target setting is presented in Case 24. This concerns the 2024 SLB issuance by Japanese utility giant JERA. JERA is the world's biggest (private) buyer of LNG, and an important player in Japan's coal import market. With Japan being the world's third largest importer of coal, and questions having been raised around the alignment of LNG use with climate goals, the JERA SLB targets assumed a high salience. The case also illustrates how setting targets is intrinsically linked to the pricing of SLBs, and, as we have seen in previous chapters, the ultimate cost-of-capital for the issuer.

This section discusses SPTs from a number of different angles: principles around targets, validation of the relevance of these targets, greenwashing risk, and diversity of targets. It also touches on trigger analysis – what happens to an SLB's pricing dynamics as the target observation date approaches. We furthermore discuss the incentive structures around step-ups and step-downs, as well as alternative, non-financial coupon step payments. The section concludes with an extended case study on target setting in the hard-to-abate chemicals sector.

# CASE STUDY 24
## TARGET SETTING: JERA TRANSITION-LINKED BOND

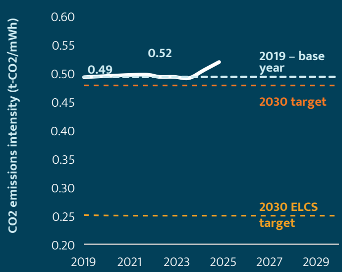
**RESEARCH: JERA: AN ENHANCED SLB PROPOSAL FOR AMBITIOUS TRANSITION, FEB 2024**

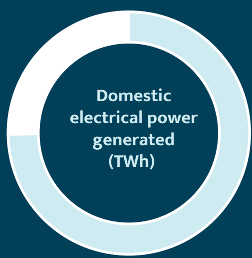
**BOND: JERA JPY1.192% 02/34 (JP338672BQ32)**

JERA, Japan's largest power generation company, has a key role to play in the country's overall decarbonisation strategy. Its transition objectives, zero $CO_2$ emissions by 2050 a 60% reduction in emissions (relative to fiscal year 2013) by 2035, are consistent with Japan's wider Green Transformation (GX) plan. Rather than actively diversifying into renewables, its development plans are targeted at improving efficiency at LNG units and introducing ammonia co-firing at coal units.

JERA came to market with a transition-linked bond, with a target to reduce emissions intensity. However, JERA's current emissions reduction targets are unambitious, especially when compared to industry peers and the nationwide target set by the country's Electric Power Council for a Low Carbon Society.

AFII proposed an enhanced SLB structure with a target that aligns with the national objective of achieving a 46% reduction in greenhouse gas emissions by fiscal year 2030, which would produce a greater impact and be strongly complementary to JERA's issued transition bonds. For investors, such a structure could deliver accountability, and ensure a focus on decarbonisation outcomes rather than untested technologies. This would benefit not only bond investors directly, but stakeholders across the capital structure.




**Case figure 24.1** (left) JERA carbon intensity; (right) current generation capacity

| | TRANSITION LINKED BOND | PROPOSED AMBITIOUS SLB |
|---|---|---|
| Maturity | 10y, Feb 2034 | 10y, Feb 2034 |
| Observation and step date | Fiscal year 2030 (Mar 2031) | Fiscal year 2030 (Mar 2031) |
| SPT 1 | 0.477 kg-$CO_2$/kWh intensity, -3% from 2019 baseline | 0.477 kg-$CO_2$/kWh intensity, -3% from 2019 baseline |
| SPT 2 | none | 0.25 kg-$CO_2$/kWh intensity, -49% from 2019 baseline, and aligned with Electric Power Council (or ELCS) target |
| Step-up | +0.1% premium (donation) on not achieving SPT1 | +37.5bps on not achieving SPT1, -37.5bps on achieving SPT2 |
| Option value | -0.5bps | -3.0bps |
| of which: | -0.5bps option value of SPT1 | -3.8bps option value of SPT1 |
| | | +0.8bps option value of SPT2 |

**Case table 24.2** (left) Actual transition-linked bond; (right) alternative, proposed SLB structure for JERA

## 4.2 TARGET-SETTING PRINCIPLES

SPTs set out the sustainability ambition to which an issuer is ready to commit, and should therefore reflect a level of progress it considers achievable and realistic. An investor should be able to gauge the probability of an SPT being achieved and the commensurate change in issuer creditworthiness that would ensue, as these variables are critical to accurately pricing an SLB relative to a vanilla issuance.

Because of their importance to the SLB structure, market participants have developed uniform standards on establishing and monitoring SPTs. Notably, the International Capital Markets Association (ICMA) has produced Sustainability-Linked Bond Principles (SLBPs) that recommend SLB structuring features, disclosure practices, and reporting processes. The principles represent industry-endorsed best practices and are increasingly being used to inform SLB structures.

On target-setting, the SLBPs lay out the following recommendations:

- SPTs should represent "a material improvement" in their respective KPIs that go beyond business-as-usual improvements.
- They should be compared to a benchmark or external reference where possible.
- They should be consistent with an issuer's overarching business and sustainability strategy (in the case of corporate issuers) or sustainable development policies (in the case of sovereign issuers).
- They should be appropriately baselined against a point-in-time set before or concurrent with the bond's issuance.
- They should be benchmarked using a combination of approaches, including the issuer's own track record on the selected KPIs, its peers' track records, and by reference to climate science or international agreements, such as the 2015 Paris Climate Agreement.

The SLBPs further provide recommendations on SPT disclosures. These should "make clear reference" to the following:

- Timelines for SPT achievement, including target observation date/periods, the trigger events, and frequency of SPTs.
- Where relevant, the verified baseline/ reference point against which KPI improvement is measured, as well as the rationale for that baseline or reference point being used.
- Where possible, how the issuer intends to reach its SPTs, for example by describing its sustainability strategy, supporting governance arrangements, and investments.
- Other key factors beyond the issuer's direct control that may affect the achievement of the SPTs.

By following these SLBPs, an SLB issuer should be able to provide investors with the information they need to efficiently price the instrument's embedded option value and determine whether or not it makes for an attractive investment. They also facilitate the setting of strong sustainability targets, thereby insulating issuers from claims that they are exaggerating their environmental commitments, a topic explored in more detail below.

Clearly, a principles-based approach to target setting is open to subjective interpretations, and the dimensionality of analysis required increases with the number of the SPTs featured in the bond. We illustrate this in Case 25, via a two-tranche SLB issuance from Air France-KLM, where some metrics adhere to the principles but question marks are raised around the use of intensity rather than absolute targets.

# CASE STUDY 25

## CARBON INTENSIVE SLB TARGETS: AIR FRANCE/KLM

**RESEARCH:** AIR FRANCE-KLM: COME FLY WITH SLBS, JAN 2023

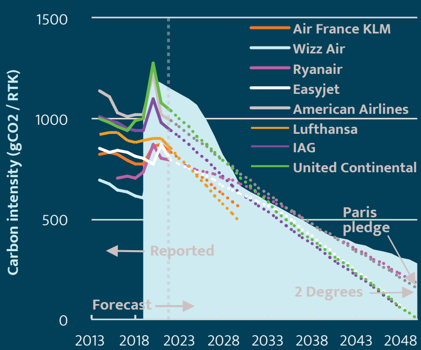
**BOND:** AFFP EUR7.25% 05/26 (FR001400F2Q0), AFFP EUR8.125% 05/28 (FR001400F2R8)

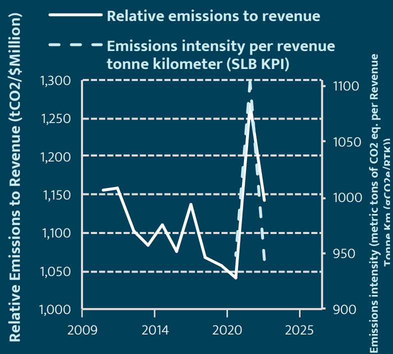
Air France-KLM issued an inaugural SLB in January 2023 as part of its commitment to reduce the GHG emissions intensity of its fleet. The offering was split into two EUR500m tranches: one with a 3.3-year maturity and another with a 5.3-year maturity, yielding 7.25% and 8.125%, respectively.

The KPIs used in the issuance are emissions intensity-based. Generally, this signals a lower level of sustainability ambition, as emissions intensity can decrease even as an issuer's absolute emissions increase, depending on the (revenue) denominator. Air France-KLM uses metric tons of $CO_2$ equivalent per Revenue Ton Kilometre ($CO_2e$/RTK) as the KPI for this SLB.

The associated SPTs commit Air France-KLM to reduce $CO_2e$/RTK 10% by 2025 and 30% by 2030 versus a 2019 baseline. Putting aside the use of an intensity-based KPI, two other characteristics of these SPTs signal a high level of sustainability ambition from the issuer. Using 2019 as the baseline is significant, as it is before the COVID 19 pandemic hit — an event which dramatically curtailed air transit. This makes the target harder to achieve than had it been set at 2020, when $CO_2e$/RTK was pushed far higher by the reduction in air travel. $CO_2e$/RTK reduced 14% in 2021 alone as air travel patterns normalised.

Furthermore, Air France-KLM says its targets have been validated by the Science Based Target Initiative (SBTi), a methodology which claims to be consistent with a "well below 2°C" warming trajectory. The alignment of the SPTs with this threshold is in keeping with the ICMA SLBPs listed above.




**Case figure 25.1** (left) Carbon intensity trajectories for airlines to reach Paris targets; (right) Air-France-KLM emissions intensity

## 4.3 SECOND PARTY OPINIONS

Given the complexity of evaluating sustainability targets and credentials, the GSSS market has attracted the services of "second party opinion" (SPO) providers that analyse and verify these for issuers. Typically, a company that is considering issuing a GSSS bond contacts an SPO provider to get its sustainability framework assessed, which the SPO does so in exchange for payment. The SPO is then added to the bond documentation package used to attract investors during the roadshow and issuance process. SPOs often refer back to the ICMA, explaining to what degree the given issuer's bond structure aligns with the organisation's SLBPs.

It is important to note that the SPO is an a priori assessment of a framework and does not assess the actual terms of a security; usually more KPIs are included in a framework than are ultimately selected for the issued bond. An SPO typically does not monitor an issuer over time to see how well it has executed its framework, either. This is unlike the credit rating process, where an agency normally tracks a company's development and adjusts its credit opinion if and when underlying fundamentals change. Withdrawals or changes to SPOs after an issuance are very rare.

An array of SPO providers across GSSS bond types is presented in Table 4.1. The market has consolidated significantly in recent years. A number of SPO providers from early on in the GSSS market's development (pre-2019) have assessed relatively few SLBs, as they are no longer independent businesses/brands. Examples include Vigeo Eiris, acquired by Moody's, and Cicero Shades of Green, acquired by S&P.

SPOs are particularly useful to investors when the bond issuer is a private entity, as the SPO provider is likely to be able to obtain more information from the issuer than it is. An example of a private company SPO from the biggest SPO provider, Sustainalytics, is provided in Case 26.

Similar to credit ratings, the provision of an SPO does not obviate the need for investors to conduct their own due diligence, since SPOs are based on information provided by the issuer themselves to the provider. This can give rise to issues of omission, and other sources of error, as illustrated in Case 27 and further discussed in the penultimate section of this chapter.

**Table 4.1** Second party opinion providers across GSSS bonds in general and the SLB market in particular. Notionals in USDbn issued. Source: ICMA, Luxembourg Stock Exchange

| PROVIDER | GSSS | % | SLB | % |
|---|---|---|---|---|
| Sustainalytics | 1 015.4 | 27.2% | 64.5 | 27.3% |
| Cicero | 700.6 | 18.8% | 0.9 | 0.4% |
| Vigeo Eiris | 603.6 | 16.2% | 17.0 | 7.2% |
| ISS-Oekom | 572.3 | 15.3% | 50.6 | 21.5% |
| Moody's | 192.3 | 5.2% | 47.4 | 20.1% |
| DNV GL | 124.0 | 3.3% | 19.7 | 8.4% |
| S&P | 81.1 | 2.2% | 7.5 | 3.2% |
| EY | 43.2 | 1.2% | 2.7 | 1.1% |
| Climate Bonds Initiative Certified | 41.9 | 1.1% | - | 0.0% |
| Deloitte | 35.2 | 0.9% | - | 0.0% |
| Japan Credit Rating Agency | 18.6 | 0.5% | 3.3 | 1.4% |
| KPMG | 10.8 | 0.3% | 0.1 | 0.0% |
| PwC | 7.5 | 0.2% | 1.3 | 0.5% |
| Other | 285.4 | 7.6% | 20.8 | 8.8% |
| **TOTAL** | **3 731.9** | **100.0%** | **235.8** | **100.0%** |

## CASE STUDY 26
## SPO EXAMPLE FOR REWE SLB

RESEARCH: SLB BUMPER WEEK, SEP 2023. SECOND PARTY OPINION REWE GROUP SUSTAINABILITY-LINKED BOND FRAMEWORK, AUG 2023

BOND: REWEEG EUR4.875% 09/30 (XS2679898184)

REWE Group, a privately-owned German retail and tourism group, is an infrequent issuer in the bond market. It issued EUR2bn in 2018 and EUR1.6bn in 2019 of Schuldshein format, which has all been prepaid. A EUR0.1bn 5y issuance from 2020 is still outstanding. The recent SLB represents its first foray into public debt markets. REWE Group is the parent company of REWE, the second largest supermarket chain in Germany. REWE Group also owns other supermarket chains across Europe. Agriculture is a key sector for nature loss concerns; hence this bond presents a chance for investors to engage with a privately-owned company in an environmentally sensitive sector.

SUSTAINALYTICS SECOND OPINION:
"Sustainalytics is of the opinion that the REWE Group Sustainability-Linked Bond Framework aligns with the Sustainability-Linked Bond Principles (SLBP) 2023." This assessment is based on the following:

- SELECTION OF KEY PERFORMANCE INDICATORS The Sustainability-Linked Bond Framework includes three KPIs for REWE and PENNY Germany: i) absolute Scope 1, 2, 3 GHG emissions; ii) absolute Scope 3 non-FLAG GHG emissions; and iii) absolute Scope 3 FLAG GHG emissions (see Table 4.1). Sustainalytics considers the KPIs chosen to be very strong, given that: i) they are a direct measure of REWE Group's performance on a relevant and material ESG issue; ii) they have a high scope of applicability; iii) they follow a clear and consistent methodology that is externally defined; and iv) they lend themselves to being benchmarked against science-based global decarbonisation pathways.
- CALIBRATION OF SUSTAINABILITY PERFORMANCE TARGETS Sustainalytics considers the SPTs to be aligned with REWE Group's sustainability strategy. Sustainalytics further considers SPT 1.3, 2.2, 2.3, 3.2 and 3.3 to be highly ambitious, SPT 1.2, 2.1 and 3.1 to be ambitious, and SPT 1.1 to be moderately ambitious based on the comparison with past performance, peer performance and alignment with science.
- BOND CHARACTERISTICS REWE Group has linked the bonds' financial characteristics to the achievement of all three SPTs. Failure to achieve these SPTs would constitute a trigger event and would lead to a step-up in the coupon or a redemption price adjustment. Sustainalytics notes that the financial characteristics of the bonds are aligned with the SLBP 2023.
- REPORTING REWE Group commits to report on an annual basis on its progress towards the KPIs, relevant information regarding recalculations, updates on the emission reduction strategy and governance affecting the KPIs' and SPTs' trajectories, and qualitative or quantitative data explaining the main factors behind the evolution of its progress towards the KPIs. This reporting will be made publicly available in a Sustainability-Linked Bond Progress Report, which will be published on the Group's website. These commitments are aligned with the SLBP 2023.
- VERIFICATION REWE Group commits to have external limited assurance conducted against each SPT for each KPI at least once a year, which is aligned with the SLBP 2023."

# CASE STUDY 27

## SPOS NEED THEIR OWN DUE DILIGENCE: ADANI ELECTRICITY

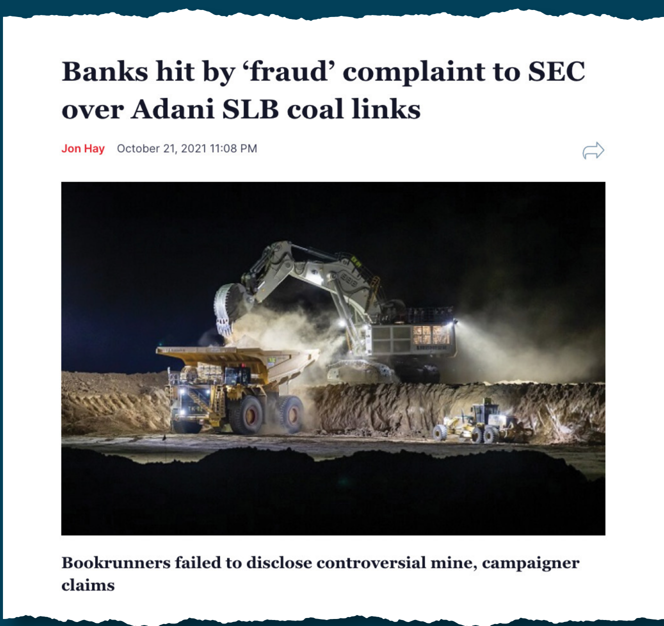
**ARTICLE:** GLOBAL CAPITAL: "BANKS HIT BY 'FRAUD' COMPLAINT TO SEC OVER ADANI SLB COAL LINKS", OCT 2021

**BOND:** ADANEM USD3.867% 07/31 (XS2367109803)

Adani Group, a major energy and fossil fuel infrastructure conglomerate, crafted a controversial SLB of its own in July 2021. The instrument, issued by one of the group's entities, Adani Electricity Mumbai Ltd, has targets linked to increasing the company's renewable power mix and reducing Scope 1 + 2 GHG emission intensity.

However, the bond's documentation does not disclose Adani Group's involvement with the Carmichael coal mine in Australia, a highly controversial thermal coal mine project. This omission deprived investors of decision-useful information that could credibly sway their investment choices. Sustainability-focused institutions initially attracted to the SLB may have rethought their allocations had they known of the Group's wider involvement in the coal industry.

Furthermore, the bond was issued with an SPO that did not flag that Adani Electricity itself was a coal-dependent utility, something which is usually tabulated in a "controversial activities" section of the SPO. This was only corrected weeks after the actual issuance. A point of contention in this issuance was the responsibility of the bank syndicate managing the issuance process for verifying the correctness of the bond prospectus and the SPO.



Banks hit by 'fraud' complaint to SEC over Adani SLB coal links

Jon Hay October 21, 2021 11:08 PM

Bookrunners failed to disclose controversial mine, campaigner claims

**Case figure 27.1** Media coverage of SEC complaint on Adani SLB issuance in 2021. Source: GlobalCapital

## 4.4 DIVERSITY OF TARGETS

When looking at the broad array of targets set in the market, sustainability-linked bonds may be somewhat misnamed, as there are KPI-linked bonds not necessarily focused on what 'sustainability' is generally understood to mean. The first general KPI-linked corporate bonds actually appeared as early as 2000. These were TMT sector bonds with coupon links to credit ratings.[1] However, in recent years, general KPI-linked and sustainability-linked bonds have become very close neighbours. 'Transition-linked' bonds may also be emerging, if Case 24 concerning Japanese utility JERA starts a trend. As argued throughout this book, a core usage of the SLB structure, irrespective of how it is named, should be to target change and transition.

Complete datasets covering the different types of KPIs used in bond transactions are not yet publicly available. Table 4.2 uses AFII's internal database, in which KPI types have been classified for a fairly large percentage of the total SLBs outstanding.

Various climate/emissions-related KPIs are clearly dominant in the SLB space, though there's a fair amount of diversity in terms of what metrics are used to target decarbonisation. As discussed in Case 25 and elsewhere in this book, a core decision is whether to use Scope 1 + 2 emissions as the KPI or also to include Scope 3 emissions. Especially for hard-to-abate sectors, like oil and gas, including Scope 3 will make absolute emission figures multiples higher, which is why there is often issuer resistance to including these numbers.

But this can go the other way too. Investors consider the 'delta' in their allocation decisions. This means that including Scope 3 in targets may actually be beneficial for issuers, in that they give investors more of the delta. An oil and gas company with a small direct emissions footprint (e.g. with little flaring and few methane leakages) that is transitioning into more renewables production will be able to target bigger footprint reductions on a percentage basis if it includes Scope 3.

Having said that, even when nominally referring to Scope 3 emissions, there seems to be some leeway to exclude important factors, as in the case of the SNAM SLB in February 2024, illustrated in Case 29.

An important dimension of SLB climate target setting concerns baselining. Specifically, issuers are meant to target changes from a predetermined baseline date. Case 28 illustrates the importance of this: choosing 2019 as a baseline for emissions that then fell drastically during Covid seems opportunistic on behalf of the issuer.

**Table 4.2** AFII SLB database[2] (restricted to SLBs with ISINs) KPI classifications. USDbn

| TYPE OF KPI METRIC | KPI1 | KPI2 | KPI3 |
|---|---|---|---|
| ABSOLUTE GHG | 156.1 | 62.1 | 7.4 |
| GHG INTENSITY | 66.0 | 16.8 | - |
| RENEWABLE CAPACITY/CAPEX | 12.8 | 2.3 | 0.4 |
| RECYCLING/MATERIALS/LAND | 10.7 | 2.1 | 0.5 |
| SOCIAL | 6.5 | 9.8 | 1.6 |
| FINANCIAL EXPOSURE TO GREEN/SBTI | 5.5 | - | - |
| ESG SCORING | 0.5 | - | - |
| **TOTAL** | **258.2** | **93.0** | **9.9** |

[1] For a further description of the early market as well as a pricing approach, see "On the Pricing of Step-Up Bonds in the European Telecom Sector", Lando, D. and Mortensen, A., SSRN, 2004.

[2] Internal data source focused on benchmark hard-currency SLBs.

# CASE STUDY 28
## AIRPORT SLBS

**RESEARCH:** AIRPORT SLBS: CLEAR FOR TAKE-OFF, JUL 2023

**BOND:** HTROW EUR4.5% 07/33 (XS2648080229), GACENO MXN10.26% 03/30 (MX91OM000076) AND MORE

**Air travel is a major contributor to climate change, accounting for 3.5% of all the drivers of global warming according to a 2020 study. In order to become more sustainable, all entities in the air transportation industry have to make changes, including airports.**

| ISSUER | TICKER | ISIN | ISSUE DATE | MATURITY DATE | ISSUE AMOUNT (BN) | CURRENCY |
|---|---|---|---|---|---|---|
| AEROPORTI DI ROMA SPA | ADRIT | XS2337326727 | 30-APR-21 | 30-JUL-31 | 0.50 | EUR |
| CAPITAL AIRPORT GROUP | CAPAPT | BBG012C4X0K3 | 27-AUG-21 | 27-AUG-26 | 2.00 | CNY |
| GPO AEROPUER CENTRO NORT | GACENO | MX91OM000050 | 31-MAR-22 | 22-MAR-29 | 2.30 | MXN |
| GPO AEROPUER CENTRO NORT | GACENO | MX91OM000068 | 31-MAR-22 | 25-MAR-27 | 1.70 | MXN |
| GRUPO AEROPORTUARIO DEL- | GAPBMM | MX91GA0000E0 | 26-SEP-22 | 21-SEP-26 | 2.76 | MXN |
| YUNNAN AIRPORT GROUP | YNARPT | CND10005RGP7 | 19-OCT-22 | 19-OCT-25 | 0.50 | CNY |
| GPO AEROPUER CENTRO NORT | GACENO | MX91OM000084 | 10-MAR-23 | 24-JUL-26 | 0.64 | MXN |
| GPO AEROPUER CENTRO NORT | GACENO | MX91OM000076 | 10-MAR-23 | 01-MAR-30 | 2.56 | MXN |
| GRUPO AEROPORTUARIO DEL- | GAPBMM | MX91GA0000F7 | 27-MAR-23 | 18-MAR-30 | 4.28 | MXN |
| GRUPO AEROPORTUARIO DEL- | GAPBMM | MX91GA0000G5 | 27-MAR-23 | 23-MAR-26 | 1.12 | MXN |
| AEROPORTI DI ROMA SPA | ADRIT | XS2644240975 | 10-JUL-23 | 10-JUL-33 | 0.40 | EUR |
| HEATHROW FUNDING LTD | HTHROW | XS2648080229 | 11-JUL-23 | 11-JUL-33 | 0.65 | EUR |

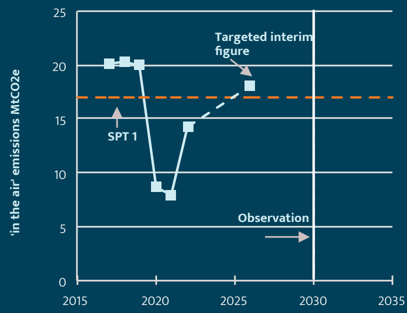
**Case table 28.1** Airport SLBs

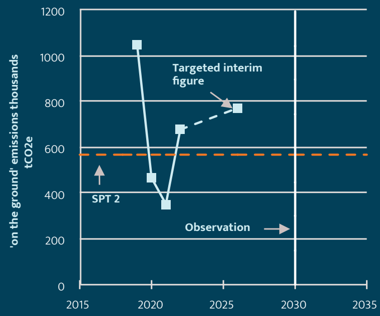
Certain airports are exploring the use of SLBs to raise the capital necessary to transition. In July 2023, Heathrow – operator of the UK's largest airport – issued an inaugural SLB with a EUR0.65bn notional, 10-year maturity, and 4.5% coupon. A 120bps coupon step-up is triggered if Heathrow fails to achieve two separate SPTs by 2030.

The first SPT is a 15% reduction in the absolute level of "in the air" carbon emissions (Scope 3) by the end of 2030 compared to a 2019 baseline. This covers emissions from aircraft during their landing and take-off cycles, as well as cruising emissions from departing flights. The second target is a reduction of "on the ground" emissions of 46.2% by end-2030, also relative to a 2019 baseline. This includes Scope 1, 2, and 3 emissions generated by the airport's buildings, transport, infrastructure, and supply chains, as well as those caused from surface access to the airport.

The inclusion of the "in the air" SPT is an industry first, and indicates a high level of climate ambition from Heathrow, as it incentivises the airport to decarbonise the airlines that use its terminals as well as its own operations. However, this also makes it less certain that the targeted reduction can be achieved. Not only does Heathrow have limited influence over the carriers, but the technology for decarbonising air travel is still at a nascent stage.

Italy's premier airport operator, Aeroporti di Roma (ADRIT), has issued two SLBs. The first, placed in April 2021, is a EUR0.5 billion notional instrument with a 10-year maturity and a 1.75% coupon. The second was issued in July 2023, with a EUR0.4 billion notional, renewed 10-year maturity, and a 4.875% coupon. The SLBs aim to incentivise a material improvement in ADRIT's



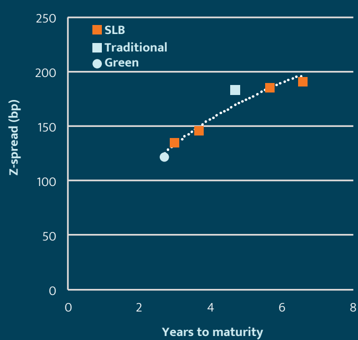

**Case figure 28.2** (left) Heathrow SLB KP1, "in the air" emissions; (right) KPI2, "on the ground" emissions

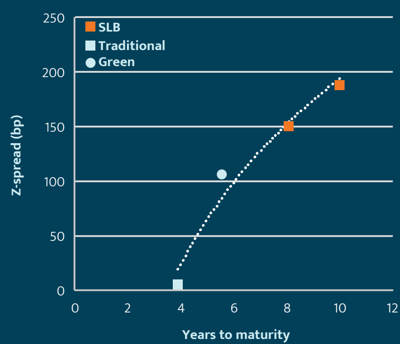
**sustainability performance as defined through two Sustainability-Linked Financing Frameworks, which set out the bonds' SPTs. Each framework covers Scope 1, 2, and 3 emissions.**

**However, in contrast to the Heathrow SLB, neither of the ADRIT bonds include aircraft emissions. Furthermore, the Scope 3 target is intensity-based. This is a weaker benchmark than an absolute target, as emissions intensity can drop even as absolute emissions rise if the number of airline passengers increases fast enough. In addition, the step-up mechanism is laddered, with coupon increases varying depending on the number of SPTs met. These factors mean the ADRIT SLB targets are less robust than those used by Heathrow. In turn, this makes them more achievable. ADRIT is therefore less likely to trigger the bonds' step-up feature then Heathrow is to trigger its own.**

**Two Mexican airports have also tapped the SLB market. Grupo Aeroportuario del Centro Norte, known as OMA, is a Mexican airport operator that has issued four SLBs – two in March 2022 and two in March 2023. The specific SPTs chosen for these SLBs are not as comprehensive as those used by other airports, such as Heathrow. For example, they do not include aircraft emissions, and utilise emissions intensity benchmarks rather than absolute targets.**

**Grupo Aeroportuario del Pacifico, known as GAP, issued one SLB in September 2022 and two in March 2023. The bonds' targets are defined under its in-house Sustainability-Linked Financing Framework, which references a single KPI – absolute Scope 1 + 2 emissions. Furthermore, the data shows the 25% reduction target had already been achieved, driven by falling passenger numbers due to the COVID-19 pandemic. This suggests the SLBs will exert a weak influence on GAP's sustainability performance.**




**Case figure 28.3** (left) GACENO bond spreads; (right) ADRIT bond spreads. Source: Bloomberg, accessed 19 Jul 2023

## CASE STUDY 29
## SCOPE 3 EMISSIONS OMISSION: SNAM

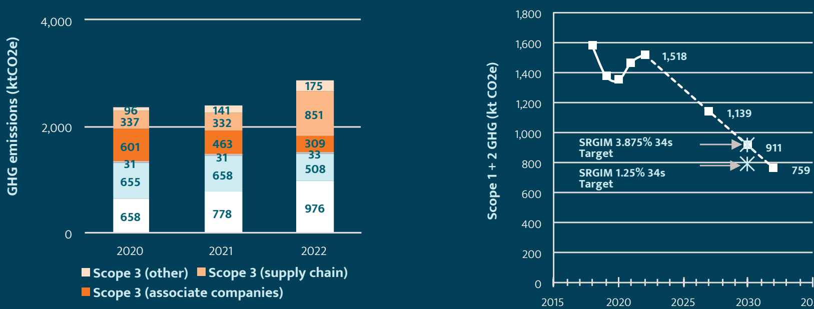
**RESEARCH: THE FORENSIC CARBON ACCOUNTANT: SNAM SPA, FEB 2024**

**BOND: SRGIM EUR3.875% 02/34 (XS2767499945)**

**Snam, an Italian gas transport and storage company, has issued several ESG-labelled bonds. In Feb 2024 it priced its first green bond, plus an SLB linked to an updated sustainability framework. The SLB was praised in the media for including a Scope 3 emissions target.**

**EMISSIONS TARGETS: Snam has two SLBs outstanding, where the KPIs are linked to Scope 1 + 2 emissions targets. In the updated framework, the targets are re-baselined to 2022, and the 2030 target is actually less ambitious in absolute terms. This created two SLBs (1.25% 34s and 3.875% 34s) with the same observation date but different targets.**

**SCOPE 3 EMISSIONS – A FULL PICTURE?: Snam's reported Scope 3 emissions only cover nine of the GHG Protocol categories, with category 11 "use of sold products" notably absent. Snam argues that it does not own the gas it transports, however guidance from CDP in 2022 makes clear that the 'throughput method' should be used to include these emissions in the total. Our estimations are that this category could represent 60x the total of Snam's reported emissions.**




**Case figure 29.1** (left) Snam reported emissions; (right) Snam Scope 1 + 2 emissions historic figures and targets. Source: Snam

In addition to climate-related performance targets, biodiversity and social factors are increasingly common (see Case 30 for an example). Biodiversity targets in particular seem well-suited for inclusion in SLBs.

For example, advances in spatial imaging make it possible to quantify deforestation and thus provide the data necessary to infer SLB target achievement probabilities.

SLBs may also include non-priceable targets, which are nonetheless important to the narratives that frame investors' impact strategies. Case 31 discusses the inclusion of a target focused on the protection of an important blue whale habitat as part of an (at the time) anticipated bond restructuring for Sri Lanka. This case is redolent of other nature-protection type bonds such as the World Bank/ South Africa's Rhino bond, and Ecuador's debt-for-nature swap Galapagos bond.

The broad diversity of targets highlights the flexibility of the SLB as an instrument, but

## CASE STUDY 30
SOCIAL KPIS: SCHNEIDER ELECTRIC

**BOND:** SUFP EUR0% CONVERTIBLE 06/26 (FR0014000OG2)

**Schneider Electric is a French company with strong ESG scores from various providers such as MSCI, Sustainalytics, S&P and Bloomberg. The company specialises in digital automation and energy management. Over the past ten years, it has been one of the tightest trading names across EUR investment grade credit.**

**Having issued a 10yr green bond as early as in 2015 (SUFP EUR1.841 10/25 [FR0013015559]) with climate/emissions-related use-of-proceeds only, the convertible SLB issued in late 2020 offered two social KPIS plus one linked to carbon emiossions. The gender diversity KPI had three sub-targets in terms of various employment metrics.**

| KPI | SPT | HORIZON | 2020 BASELINE |
|---|---|---|---|
| KPI 1: SAVED AND AVOIDED $CO_2$ EMISSION TO OUR CUSTOMERS | SPT 1: DELIVER 800 MEGATONS SAVED AND AVOIDED $CO_2$ EMISSIONS TO OUR CUSTOMERS | 2025 | 280 MEGATONS $CO_2$ EMISSION SAVED AND AVOIDED TO OUR CUSTOMERS |
| KPI 2: GENDER DIVERSITY FROM HIRING TO FRONT-LINE MANAGERS AND LEADERSHIP TEAMS | SPT 2: INCREASE GENDER DIVERSITY, FROM HIRING TO FRONT-LINE MANAGERS AND LEADERSHIP TEAMS:<br>2a) 50% WOMEN HIRING<br>2b) 40% WOMEN AMONG FRONT-LINE MANAGERS<br>2c) 30% WOMEN IN LEADERSHIP | 2025 | 2a) 43% WOMEN HIRING<br>2b) 25% WOMEN FRONTLINE MANAGERS<br>2c) 23% WOMEN IN LEADERSHIP |
| KPI 3: NUMBER OF UNDERPRIVILEGED PEOPLE TRAINED IN ENERGY MANAGEMENT | SPT 3: TRAIN 1 MILLION UNDERPRIVILEGED PEOPLE IN ENERGY MANAGEMENT | 2025 | 268,000 PEOPLE TRAINED |

**Case table 30.1** Schneider Electric KPIs. Source: Company

the downside is they create non-standardised bonds, making relative value (financial and impact) analysis more difficult as there are few apples-for-apples comparisons. Use of non-priceable targets also makes the impact of these instruments opaque. Still, one has to recognise the novelty of the SLB as an instrument, and there are industry efforts underway to promote standardisation.

As discussed further in Chapter 5, using multiple KPIs also makes pricing more difficult as one has to start making correlation assumptions around targets. Anecdotally, more recent issuances of SLBs have had fewer KPIs.

Another deduction from the pricing exercise in Chapter 5 is that, in order to maximise the option premium in the SLB, KPIs should be uncorrelated rather than correlated. This suggests that, for example, an SLB with a carbon reduction target and a renewable energy target (highly correlated) may obtain a smaller option premium than an SLB with a similar carbon reduction target and a social target (less correlated). This target combination is something that could be deployed in so-called “just transition” structures.

## CASE STUDY 31
## DISTRESSED RESTRUCTURING WITH BIODIVERSITY: SRI LANKA

**RESEARCH:** SRI LANKA: RESTRUCTURING WITH BIODIVERSITY-LINKS?, FEB 2022

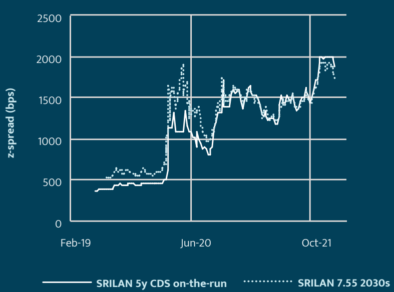
**BOND:** SRILAN USD7.55% 03/30 (USY8137FAR92)

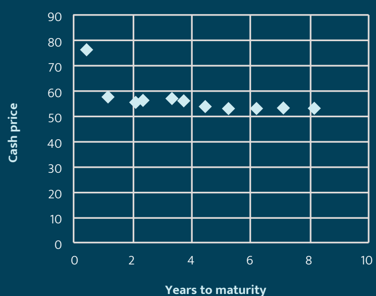
Sri Lanka government bonds (15bn of USD-denominated bonds outstanding) are currently trading at distressed levels, implying a market expectation of default and/or restructuring in the near term. The combination of Sri Lanka's efforts to tap into green funding in 2021, the country's climate change vulnerability, and the high demand for positive impact assets among international investors makes it seem natural to involve some sustainability criteria in a potential restructuring of USD bonds.

DEFORESTATION is eroding terrestrial biodiversity in Sri Lanka. The country has lost approximately 10% of its forest cover since 1990, with the forestry industry being the dominant driver according to Global Forest Watch. Although the forest loss rate has slowed considerably, thanks to implemented conservation measures and an increase in protected areas, the country's growing population continues to increase land use pressures.

GENERAL MARINE BIODIVERSITY PROTECTIONS In line with Aichi Biodiversity Target 11, the country had committed in its biodiversity action plan to have 10% of its coastal and marine areas protected by 2020. According to the Integrated Biodiversity Assessment Tool, only 0.07% of Sri Lanka's marine areas are protected as of 2021. Tourism accounted for 4.9% of the country's GDP pre-Covid, with coastal tourism being highly dependent on a rich marine biodiversity. Furthermore, according to the World Bank, "fish make up about 50% of Sri Lankans' animal protein intake, a ratio three times higher than the global average." Thus, a sustainable management of Sri Lankan marine life is essential for continued food security and employment opportunities.

WHALE HABITAT PROTECTION One of the busiest global shipping routes passes close to the southern tip of Sri Lanka, which is also the habitat of a unique sub-species of blue whale. A minor shift to the route could substantially reduce any impacts to the whale populations inhabiting Sri Lanka's southern coastline, see: "'Giant obstacle course': call to reroute major shipping lanes to protect blue whales", The Guardian, 7 Feb 2022. Whale populations have been brought to the forefront in terms of climate- and environmental actions as of late, cf. "Shell-shocked: a whale trade in corporate bonds", AFII, 1 Dec 2021. We believe that whale protection conditionalities could provide a fillip for asset managers and asset owners representing environmentally conscious stakeholders, as the specificity of the target carries powerful messaging potential for end investors.




**Case figure 31.1** (left) Sri Lanka CDS and long-end bonds up to Feb-2022, (right) distressed, flat cash curve of Sri Lanka bonds in Feb-2022. Source: Bloomberg, AFII

## 4.5 STEP-UP OR STEP-DOWN?

From a purely theoretical financial analysis perspective, whether an SLB features a step-up or step-down should be a non-issue, as the expected value of the transaction should be the same and it is assumed that both investors and issuers are risk-neutral and indifferent to the format.

In practice, the step-up format is dominant, with over 95% of SLB adjustments being step-ups rather than step-downs. This is a very different picture to the (loan) SLL market, where most structures employ step-downs.

For investors, **the step-up format** is of course the easier to explain: if the issuer fails to reach a stretch target, the investor should be compensated with a higher return. This type of SLB format also dovetails with traditional step-up structures elsewhere in the bond market.

Furthermore, bond investors, like insurance companies, that use the instruments to match future liabilities may need to have investments that generate a minimum yield, and thus would refrain from investing in step-down structures.

Even so, some investors do seem to be nervous about actually getting paid a stepped-up coupon in the event an issuer misses its targets (see the next section on trigger analysis). It is argued that receiving a financial benefit when targets are missed creates a fundamental lack of alignment for sustainability-minded investors: "Why should I as an investor benefit financially when a sustainability target is missed?"

This overlooks two fundamental points: first, as shown in the pricing chapter, the step-up should have been already "paid for" by providing a cheaper cost-of-capital to the issuer prior to the step-up. In other words, the step-up is a normalisation of the interest rate provided to the investor over the life of the bond. Second, a step-up should be considered by the investor as compensation to offset the increased risk to the issuer caused by its failure to meet sustainability targets. This is the key point in Chapter 3's discussion of sustainability-credit risk correlation.

In contrast, **step-down structures** are struggling for popularity among investors due to the nature of hardcoding a potentially lower return (coupon) in the future. This feature may be an obstacle to certain investors because of their fiduciary duties, among other things. No investor likes a lower return, unless it is associated with lower risk. Hard data showing that achieving SPTs leads to issuers becoming less risky are in short supply.

Theoretically, the lower future return (coupon) in the step-down SLB should be compensated by a higher-than-baseline return (coupon) today, but this is rarely observed in practice. Issuers are not keen to place SLBs if initial coupons are over and above what they could get by issuing vanilla debt. It is simply hard for a CFO to argue in favour of issuing bonds that are more expensive (in fiscal year terms) than vanilla bonds.

Sovereign issuers provide a special case. Some jurisdictions have legal constraints on taking on debt where the cost of the debt may increase over time. This is naturally explained by electoral cycles: if the current government can shift the costs of debt assumed today onto the next government, as could be argued is the case when issuing step-up SLBs, it may lead to skewed incentives to take on excessive debt today.

On the flipside, a step-down SLB could be complicated for some sovereign issuers that may have technical requirements barring them from selling debt more expensively (in yield cost terms) than current debt. We discuss potential solutions to this problem in the advanced pricing chapter, as the step-down structure may be especially relevant for developing nations – where the highest impact in terms of financing climate transition and resilience could be achieved.

In Case 32, Uruguay's solution of including both step-up and step-down features in the same structure is discussed. This allows the instrument to price flat to an equivalent vanilla bond, but still with significant optionality.

## CASE STUDY 32
## STEP-UP OR STEP-DOWN? OR BOTH: URUGUAY

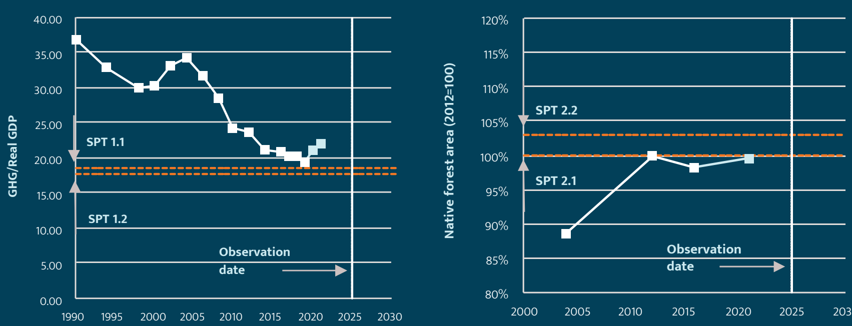
**RESEARCH: UNDERSTANDING DYNAMICS BETWEEN SUSTAINABLE AND TRADITIONAL DEBT; URUGUAY SLB: MARKET UPDATE, JAN 2023**

**BOND: URUGUA USD5.75% 10/34 (US760942BE11)**

Uruguay had never sold sustainable debt until, in Oct 2022, it issued a novel symmetric step-up and step-down structure where there are penalties/rewards for missing/achieving targets. The bond in question, the URUGUA USD5.75 34s, has two KPIs: aggregate GHG emissions per real GDP unit and native forest area. Both KPIs have two SPTs. Achieving neither will result in a step-up, but achieving both will result in a step-down to the coupon.

From a pricing point of view, there are four options in the structure. Historical data for both KPIs shows the current trend is misaligned with both targets, which gives a model value for the step-ups higher than for the step-downs. Interestingly, as the step-ups are more ITM the bond offers a positive option value to investors, but the issuer still has the incentive of a potential step-down. This could eventually lead to a situation where the expected total option value is zero, which may offer a work-around for certain restrictions on taking on debt at a yield different from the secondary-curve-implied level.

A similar structure with a combined step-up for missing targets and step-down for overachieving versus targets was discussed in Case study 14 on an SLB proposal for the Japanese sovereign.




**Case figure 32.1** (left) KPI1 Aggregate GHG/Real GDP for Uruguay; (right) Native forest area with 2012 as baseline year (=100)

## 4.6 UNDERSTANDING TRIGGERS[3]

Trigger events are those that change the risk-return profile of an SLB. These events occur if and when SPT(s) are observed to have been achieved or missed on the relevant "trigger dates."

"Trigger dates" are critical periods in the life of these instruments, with important implications for pricing and market dynamics. Depending on the structure of the SLB, achieving (or missing) an SPT(s) on the trigger date will result in the bond's coupon stepping up, stepping down, or staying flat.

Because of this, triggers play a significant role in determining the risk-reward profile of SLBs and are important for investors to understand if they are to price the instruments accurately.

### 4.6.1 TRIGGER DATES: ALIGNING INCENTIVES

The placement of trigger dates in the lifetime of an SLB represents a trade-off between investors and issuers.

Investors may want a trigger date to be as early as possible in the bond's tenor to increase the materiality of the coupon step-up, which only applies after that date. This also reduces the time during which the investor is exposed to the company's sustainability performance.

However, in order to align incentives, a trigger date should be set so that the step function is financially material to the issuer as well. The date needs to be set early enough in the bond's tenor so that the SPTs represent a "stretch goal" to the issuer, which is rewarded in turn with the avoidance of a financially penalising step-up (or financially beneficial step-down). On the other hand, it cannot be so early in the bond's tenor that it is not feasible for the target to be achieved, or unlikely that the actions of the issuer can make a difference. The step-up/down option's financial value will of course be highly dependent on these trade-offs.

At present, SLB trigger dates are usually singular. However, an SLB could be structured so that observations and associated coupon steps are made continuous. For example, an SLB could have one trigger date at its tenor mid-point and additional trigger dates each subsequent year until maturity, with step-ups/downs linked to each. This would increase the length of time under which SPTs are monitored and reduce the investor's and issuer's exposure to a single trigger date. However, it would also make pricing the SLB more complex, which could in turn hinder SLB market growth. An example of continuous triggers is shown in Case 33, which describes Polish energy company PKN Orlen's experience triggering first a step-up and then a reversal/step-down following its ESG rating developments.

### 4.6.2 HIT OR MISS? TARGET OBSERVATION

A trigger observation has several implications. Firstly, it monetises the value of the SLB's embedded option. On the trigger date, investors and issuers learn whether or not the instrument's step feature is activated, which in turn affects the financial value and potential upside of the bond.

If an SPT(s) is hit on the trigger date, the outcome depends on the specific structure and step mechanics of the bond. In some cases, hitting the target may result in a significant financial impact, if an associated step-down is sufficiently material. In others, achieving the target simply means a step-up is not activated. On the one hand, this means an investor is not awarded higher coupon payments, depriving them of a higher income stream. On the other, achieving the target could improve the creditworthiness of the issuer, increasing the market value of the instrument.

However, with certain bonds an avoided step-up or activated step-down may not have a substantial financial value or may have a short pay-out period. In such instances, the SLB may be considered "weak" and a trigger observation may not materially influence the price of the instrument.

[3] Research on which this section is based: "SLBs: a summary of 2023 targets", AFII, Nov 2023; "A review of SLBs approaching KPI observation dates", Nov 2022; "SLB triggers: what next if Nobian or PPC miss their targets?", Feb 2023.

If an SPT(s) is missed, it can have various consequences. For the issuer, failing to achieve the target may result in a higher cost-of-capital if a step-up is activated. The investor, in turn, would receive upside in the form of higher coupons, but may also accrue increased credit risk exposure. The precise impact will depend on the severity of the step-up and frequency of the higher coupon payments, as well as the credit effect of the target being missed.

In addition, a missed target can introduce uncertainty regarding the likelihood of an issuer achieving future sustainability goals and may affect the market perception of its credibility. In this context, a missed target can be considered a "thematic default" that fundamentally alters sustainability-focused investors' relationship with an issuer.

### 4.6.3 IMPACT ON SLB PRICING

The market price of an SLB should be sensitive to trigger observation dates, considering that these occasions have the potential to materially impact their financial value. Price volatility is to be expected in the run-up to a trigger date, especially where uncertainty surrounds the issuer's likelihood of achieving its SPTs.

Again, the degree of volatility depends in part on the materiality of the SLB's step-up/down feature. For example, among recent SLB issuances, step-ups may be too slight to affect pricing – or be insufficient to fully mitigate the adverse effects of a missed SPTs, such as deteriorating credit and technical flows.

The following case studies (33 and 34) illustrate the effect (or lack thereof) of trigger dates on SLB pricing.

**Table 4.3** SLBs with KPI observation dates in 2023. As seen in Nov 2023. Source: AFII, Bloomberg

| ISSUER | ISIN | ISSUE DATE | MATURITY | OBSERVATION DATE | CURRENCY | AMOUNT OUTSTANDING | STATUS |
|---|---|---|---|---|---|---|---|
| CHINA CONSTRUCT BANK/HK | XS2331713102 | 22-APR-21 | 22-APR-26 | 31-DEC-23 | USD | 0.55 | CURRENTLY MET |
| ENEL FINANCE INTL NV | XS2353182020 | 17-JUN-21 | 17-JUN-27 | 31-DEC-23 | EUR | 1.00 | LIKELY MISS |
| ENEL FINANCE INTL NV | XS2353182293 | 17-JUN-21 | 17-JUN-30 | 31-DEC-23 | EUR | 1.25 | LIKELY MISS |
| ENEL FINANCE INTL NV | US29278GAN88 | 12-JUL-21 | 12-JUL-28 | 31-DEC-23 | USD | 1.00 | LIKELY MISS |
| ENEL FINANCE INTL NV | US29278GAP37 | 12-JUL-21 | 12-JUL-31 | 31-DEC-23 | USD | 1.00 | LIKELY MISS |
| ENEL FINANCE INTL NV | US29278GAM06 | 12-JUL-21 | 12-JUL-26 | 31-DEC-23 | USD | 1.25 | LIKELY MISS |
| ENEL FINANCE INTL NV | XS2390400633 | 28-SEP-21 | 28-MAY-26 | 31-DEC-23 | EUR | 1.25 | LIKELY MISS |
| ENEL FINANCE INTL NV | XS2390400716 | 28-SEP-21 | 28-MAY-29 | 31-DEC-23 | EUR | 1.00 | LIKELY MISS |
| ENEL FINANCE INTL NV | XS2432293673 | 17-JAN-22 | 17-NOV-25 | 31-DEC-23 | EUR | 1.25 | LIKELY MISS |
| ENEL FINANCE INTL NV | US29278GAV05 | 15-JUN-22 | 15-JUN-25 | 31-DEC-23 | USD | 0.75 | LIKELY MISS |
| ENEL FINANCE INTL NV | US29278GAZ19 | 14-OCT-22 | 14-OCT-25 | 31-DEC-23 | USD | 0.75 | LIKELY MISS |
| EQT AB | XS2338570331 | 14-MAY-21 | 14-MAY-31 | 31-DEC-23/ 31-DEC-26 | EUR | 0.50 | MET 2023 TARGET |
| FORVIA SE | XS2553825949 | 15-NOV-22 | 15-JUN-26 | 31-DEC-23 | EUR | 0.95 | CURRENTLY MET |
| KNORR-BREMSE AG | XS2534891978 | 21-SEP-22 | 21-SEP-27 | 31-AUG-23 | EUR | 0.70 | MET |
| ORBIA ADVANCE CORP SAB | US68560EAA64 | 11-MAY-21 | 11-MAY-26 | 31-DEC-23 | USD | 0.60 | LIKELY MEET |
| PUBLIC POWER CORP | XS2359929812 | 21-JUL-21 | 31-JUL-28 | 31-DEC-23 | EUR | 0.50 | 50:50 |
| REXEL SA | XS2332306344 | 05-MAY-21 | 15-JUN-28 | 31-DEC-23 | EUR | 0.40 | CURRENTLY MET |
| REXEL SA | XS2403428472 | 10-NOV-21 | 15-DEC-28 | 31-DEC-23 | EUR | 0.60 | CURRENTLY MET |
| SAN MIGUEL INDUSTRIAS | US79911QAA22 | 02-AUG-21 | 02-AUG-28 | 31-DEC-23 | USD | 0.38 | 50:50 |
| YUNNAN ENERGY INST OVR | XS2445143329 | 21-APR-22 | 21-APR-25 | 31-DEC-23 | USD | 0.23 | LIKELY MEET |

**Table 4.4** ENEL KPI evolution over time. ENEL 2023 SPT was 148. $gCO_2e/kWh$)

| DATE | RENEWABLES (GWh) | NUCLEAR (GWh) | RUSSIA (NON RENEWABLES) (GWh) | COAL (GWh) | OTHER (GWh) | TOTAL POWER GENERATED (GWh) | COAL/ CONVENTIONAL | RENEWABLES/ TOTAL | SCOPE 1 INTENSITY ($GCO_2E/KWH$) |
|---|---|---|---|---|---|---|---|---|---|
| H1 2021 | 54,748 | 12,815 | 9,722 | 5,803 | 22,731 | 105,819 | 15.2% | 51.7% | 207 |
| H2 2021 | 54,070 | 12,689 | 11,526 | 8,055 | 30,446 | 116,786 | 16.1% | 46.3% | 247 |
| H1 2022 | 54,741 | 13,447 | 10,056 | 9,937 | 27,325 | 115,506 | 21.0% | 47.4% | 237 |
| H2 2022 | 57,708 | 13,061 | 0 | 9,785 | 31,707 | 112,261 | 23.6% | 51.4% | 221 |
| H1 2023 | 60,460 | 12,441 | 0 | 6,881 | 22,217 | 101,999 | 23.6% | 59.3% | 173 |
| Q3 2023 | 33,527 | 6,916 | 0 | 2,664 | 13,156 | 56,263 | 16.8% | 59.6% | 161 |

Table 4.3 shows analysis of SLBs with targets in 2023, with at-the-time assessments of whether the targets would be met or not.[4] Of particular note in this table is the volume of outstanding Enel SLBs that have the potential to step-up. At the time, the Enel bonds affected were about 5% of the total SLB market, making analysis of these instruments essential to understanding bond values.[5] In April 2024, it was announced by the company that the targets for 2023 would be missed and that consequently USD11bn of SLBs would see a step-up in the coupon. At the time of publication of this book, the full dynamics of this had not unfolded, although a quick price reaction – as detailed in Case study 9 – ensued. A first analysis was provided in "Enel SLBs: fortes fortuna juvat", AFII, 26 April 2024.

## 4.7 ALTERNATIVE STEPS[6]

Certain issuers have placed SLBs that do not include the potential for a coupon step-up/ step-down. Instead, other consequences occur when the SPTs are missed. While these may have similar financial impacts to the issuer, the resulting products are very different from an investor perspective. What follows is a rundown of some of the alternative SLB 'steps' observed in the market to date.

### 4.7.1 CHARITABLE DONATIONS

It is reported that 1.71%[7] (an estimated USD2.1bn)[8] of SLBs issued to Feb 2022 were structured to pay an equivalent charitable donation rather than a coupon pay-out if the issuer misses its SPT(s). While this is a small percentage of the overall market, we do see growth in certain regions, such as Japan. We cover one example in Case 35, to showcase the potential benefits/challenges of such products. The JERA bond in Case 24 also embedded a charitable donation feature.

Typically, the recipients of the charitable donations are aligned with the SLB issuer's KPIs. However, there is no direct link between donation outcomes and sustainability performance, meaning these kinds of SLBs seldom align with investor objectives. A more compelling approach would be to disclose which charity receives the penalty payment and what outcomes the donation will achieve. To strengthen the structure, the issuer could also commit to remediation plans to achieve the target at a later point in time.

One technical reason why the charitable donation solution may appeal is that it offers sustainability-linked structures for investors that for some reason may not want to, or be able to, invest in variable coupon bonds.

[4] For full analysis please see "SLBs: a summary of 2023 targets", AFII, 15 Nov 2023. Note the PPC rating has been adjusted in line with later analysis, see Case 34.

[5] Full research note in "Enel SLBs: market update", AFII, Nov 2023.

[6] This section's analysis was originally published as "Sustainability-Linked Bonds: alternative steps", AFII, 22 May 2023.

[7] "The Economics of Sustainability Linked Bonds", ECGI, Sep 2022.

[8] Estimated using 1.71% from reference note and all SLBs issued before 28 Feb 2022 sourced from Bloomberg.

[9] "Voluntary carbon markets: how they work, how they're priced and who's involved", S&P, 10 Jun 2021.

# CASE STUDY 33

## STEPPING UP AND THEN DOWN ON AN ESG RATING: PKN ORLEN

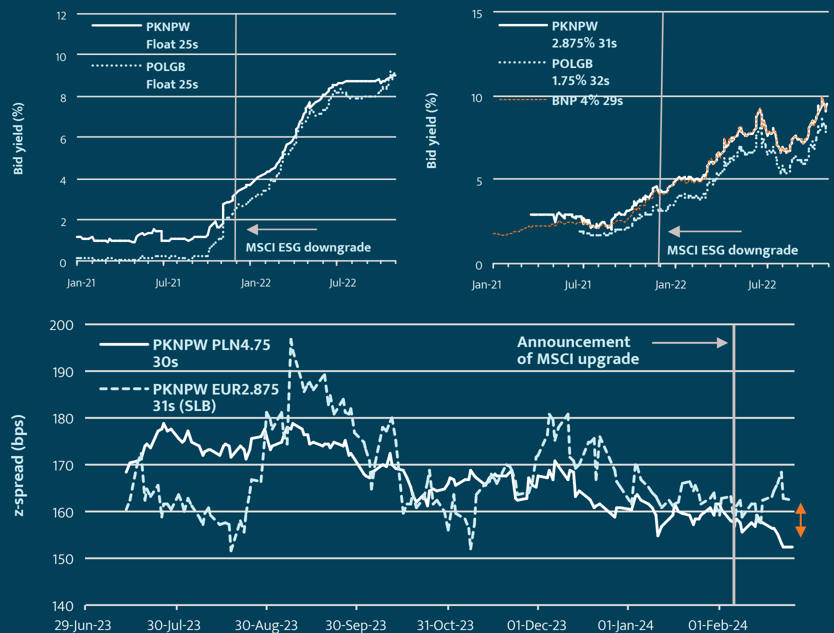
**RESEARCH: ONE SMALL STEP FOR ORLEN, ONE GIANT LEAP FOR THE SLB MARKET, NOV 2022. HERE WE GO ORLEN: SLBS STEP BACK DOWN, FEB 2024**

**BOND: PKNPW PLN2.875% 03/31 (PLO037100016), PKNPW PLN FRN 12/25 (PLPKN0000208)**

Orlen, a Polish oil refiner and petroleum retailer, has two SLBs outstanding, one issued in December 2020 maturing in December 2025, and another in March 2021 maturing in March 2031. Each has an SPT linked to Orlen's ESG rating, as determined by MSCI. In December 2021, Orlen was downgraded from A to BBB by MSCI, which triggered a step-up in the coupon on both bonds, the first by 5bps and the second by 10bps.

Market reaction to the target miss was muted (case figure 4.11). This was largely a reflection of the small size of the coupon steps. The 5bps step-up on the 2025 bonds represents 1.3% of the yield in December 2021, and the 10bps on 2031 bonds 2.1%. This may have been too small an upside to investors to have warranted a corresponding tightening in the bonds' spreads. However, there was also no evidence of a material widening, which could have been indicative of a "thematic default" and selling by green investors.

In Feb 2024, Orlen was upgraded by MSCI back to A again, thus leading to the first situation in the SLB market, to our knowledge, of a reversal of a step-up in an SLB.




**Case figure 33.1** Bid yields on PLN bonds prior to MSCI ESG rating downgrade (top figures) and after being upgraded again (bottom figure, the solid line is the spread of the PLN SLB). Source: Bloomberg, accessed 23 Nov 2022

# CASE STUDY 34
## HIT VS MISSED TARGET: PPC

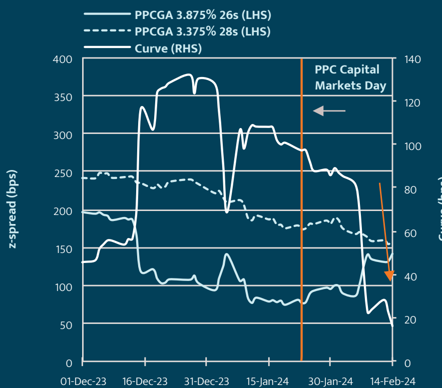
**RESEARCH: PPC: COAL DECOMMISSIONING SUCCESS IMPACTS SLBS, FEB 2024. SLB TRIGGERS: WHAT NEXT IF NOBIAN OR PPC MISS THEIR TARGETS, FEB 2023**

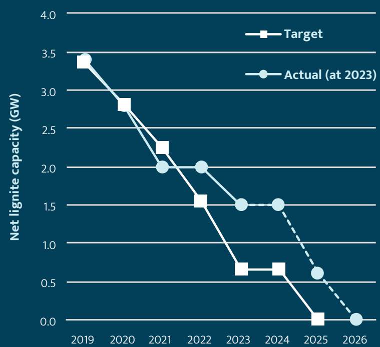
**BOND: PPCGA EUR3.875% 03/26 (XS2314265237), PPCGA EUR3.375% 07/28 (XS2359929812)**

PPC, the largest electricity supplier in Greece, operates several coal power plants. Despite ambitious plans to replace this generation with renewables, its strategy has been challenged by energy security concerns in Europe. PPC is also an issuer of SLBs, with both of its outstanding bonds using this structure. Embedding sustainability targets into bonds supports disclosure and accountability, and in PPC's case it appears this has created a strong incentive to deliver on its targets. Monitoring performance versus targets is essential for SLB investors.

On 24 Jan 2024 at PPC's Capital Markets Day, new guidance was given on its recent coal decommissioning successes, revealing that 0.5GW was closed in 2023. Its 2022 SLB target was missed, resulting in the shorter-dated bond paying a 50bps step-up. This new reporting suggested it may be back on track to meet its 2023 target. Key takeaways:

- The coal decommissioning trajectory is projected to complete one year after the original target. The reporting on emissions is insufficient, meaning it is not possible at the time of writing to be completely confident the 2023 target will be achieved, but it does seem more likely.
- A higher probability of achieving the target translates into a lower probability of receiving the step-up coupon. We would expect this to widen the longer-dated bond spread or steepen the bond curve compared to the shorter-dated SLB, which has activated a step-up coupon.
- Since the announcement, the PPC bond curve has flattened from around 80bps to 20bps, alongside some market weakness. The full implication for SLB pricing of the announcement may not yet have been digested.




**Case figure 34.1** (left) Historic PPC bond spreads (bps, LHS) and curve (bps, RHS). Source: Bloomberg, accessed 15 Feb 2024; (right) PPC net lignite capacity, targets and reported to 2023. Source: PPC

### 4.7.2 CARBON OFFSET PURCHASES

Carbon credits are market-based instruments used by companies that cannot reduce their emissions to compensate for their ongoing pollution. Holders can "retire" credits, each of which is typically equivalent to one metric ton of $CO_2$ or equivalent GHG reduced, avoided, or removed, to offset their own emissions.[9] While there are outstanding questions over which types of projects are capable of generating credible carbon credits,[10] both voluntary and compliance markets allow companies to claim lower net carbon emissions after the cancellation of purchased instruments. The price of carbon credits, particularly voluntary credits, has fluctuated in the recent past.[11]

It is reported that 1.71% of SLBs issued to Feb 2022 were structured to include purchases of carbon offsets[6] (the same proportion as for a charitable donation, five bonds in the analysis), i.e., still a relatively low but potentially growing percentage. An example of such a structure is provided in Case 36, where we show there can be certain size inconsistencies between targeted emissions reductions and the actual amount of carbon credits bought upon missing those targets.

### 4.7.3 RENEWABLE ENERGY CERTIFICATES

A Renewable Energy Certificate (REC) is a tradeable instrument representing any one megawatt-hour of electricity generated from renewable energy sources and transferred to the grid.[12] It is sometimes called an Energy Attribute Certificate (EAC).[13]

There are ongoing questions on the usage of RECs, in that they can facilitate selective emissions reporting.[14] Nevertheless, they produce additional financial benefits for producers of renewable energy, and as such are important drivers of investment in renewable energy production. As highlighted in Case 37, buying RECs can be seen as an alternative way of procuring renewable power that the issuer had hoped to generate using their own capacity.

[10] "Fear of greenwashing is 'main barrier' to corporate use of carbon credits", Responsible Investor, 16 Jan 2023.

[11] "Global carbon pricing generates record $84 billion in revenue", World Bank, 24 May 2022.

[12] "Renewable energy certificates (RECs)", EPA, accessed 4 May 2023.

[13] "What is an Energy Attribute Certificate – EAC", Ecohz, accessed on 4 May 2023.

[14] Scope 2 emissions can be reported using either a "location-based" or "market-based" method. The location-based method uses an average from grid production, while market-based allows a user to buy rights to renewable production. Where alternative methods are chosen for different users, this would lead to total Scope 2 emissions not equalling total usage when considering the whole grid. For more details please see "Scope 3: Omission impossible", LGIM, 24 Apr 2023.

## CASE STUDY 35
### ALTERNATIVE STEPS, CHARITABLE DONATIONS: SHISHEIDO

**RESEARCH: SUSTAINABILITY-LINKED BONDS: ALTERNATIVE STEPS, MAY 2023**

**BOND: SHISEI JPY0.45% 12/27 (JP335160ANC1)**

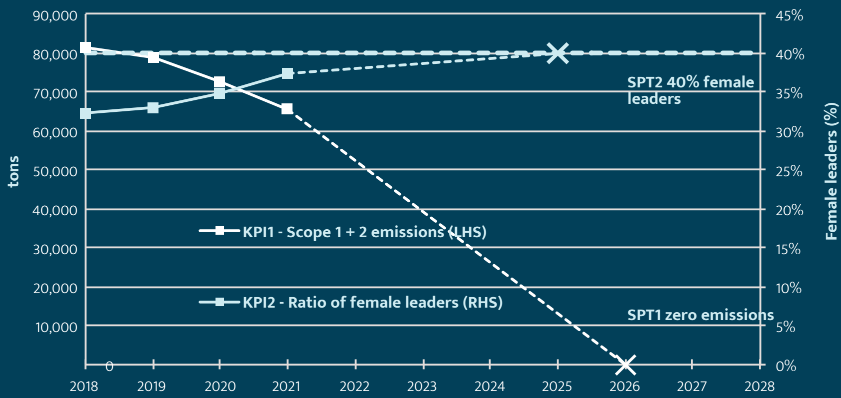
In December 2022, Shiseido, the Japanese cosmetic company, issued JPY20bn of a 10y SLB where charitable donations would be made in the event of missing either of two SPTs. The coupon paid was 0.45%, and the charitable donation would be 0.05% of notional for each missed SPT.

KPI1 is Scope 1 + 2 emissions, with a target of carbon neutrality by 2026, including emissions credits purchase. Reported figures for 2021 show emissions of 65,481 tons.

KPI2 is the ratio of female leaders, with a target of 40%. Reported figures for 1 Jan 2022 show 37.3%.

If either target is missed, "[there will be a] donation [...] to a public interest incorporated association, public interest incorporated foundation or international organisation working for environmental preservation, empowerment of women or gender equality."[9]

While the penalty, 0.05% or 0.1%, may seem small, the bond has a very low standard coupon, set at 4.5% of total cumulative interest. As a percentage of total cumulative interest, this would be equivalent to paying 0.25% in the final three years of a 10y bond with coupon 3.375%. This seems inline, or even slightly higher, than step-up payments in current SLB structures.




**Case figure 35.1** KPI evolutions for Shisheido's 2027 SLB issuance SPTs. Source: Shisheido

# CASE STUDY 36
## ALTERNATIVE STEPS, CARBON CREDITS: KAJIMA CORP

RESEARCH: SUSTAINABILITY-LINKED BONDS: ALTERNATIVE STEPS, MAY 2023

BOND: KAJIMA JPY0.554% 03/28 (JP321020AP39)

In March 2023, Kajima Corporation, a Japanese construction company, issued an JPY10bn SLB with a maturity of 5 years (ISIN JP321020AP39) where either charitable donations would be made, or carbon credits would be purchased, in the event of missing an SPT.

The KPIs referenced are Kajima's Scope 1 + 2 emissions and its Scope 3 emissions, both with reduction targets for 2030 (although the SLB will observe an interim target at the end of 2027) relative to a 2021 baseline. A third KPI is the CDP Climate Change Score, with a target to rank at a Leadership Level.

Kajima has already issued other thematic bonds, but this is its first SLB. Most of Kajima's emissions are released through its construction activities, which involve carbon-intensive concrete and steel products. Construction is considered a 'hard-to-abate' sector, and so using an SLB to offer a transparent commitment to decarbonising should be viewed positively.

Using an average price of USD5/ton for carbon credits, we can convert the proposed penalty into a total amount of carbon credits to be purchased, which is equivalent to 9,398 tons of $CO_2$. We can then compare this with Kajima's annual emissions.

In summary, the emissions reduction from offsets is equivalent to 5% of the firm's annual Scope 1 + 2 emissions. This is far less than the decarbonisation committed to under the SLB structure.

| YEAR | TARGET SCOPE 1+2 EMISSIONS | TARGET SCOPE 3 EMISSIONS | EMISSIONS REDUCTION IF TARGETS IS ACHIEVED | EMISSION REDUCTION FROM PURCHASED OFFSETS |
|---|---|---|---|---|
| 2021 | 191,000 | 6,750,000 | | |
| 2022 | 182,511 | 6,562,500 | -195,989 | |
| 2023 | 174,022 | 6,375,000 | -391,978 | |
| 2024 | 165,533 | 6,187,500 | -587,967 | |
| 2025 | 157,044 | 6,000,000 | -783,956 | |
| 2026 | 148,556 | 5,812,500 | -979,944 | |
| 2027 | 140,067 | 5,625,000 | -1,175,933 | -9,398 |
| | | Total: | -4,115,767 | -9,398? |

**Case table 36.1** Comparison of Kajima emissions reductions between SLB target and purchased offsets. Source: AFII, Kajima

# CASE STUDY 37

## ALTERNATIVE STEP, RE CERTIFICATES: BTSTB

**RESEARCH: SUSTAINABILITY-LINKED BONDS: ALTERNATIVE STEPS, MAY 2023**

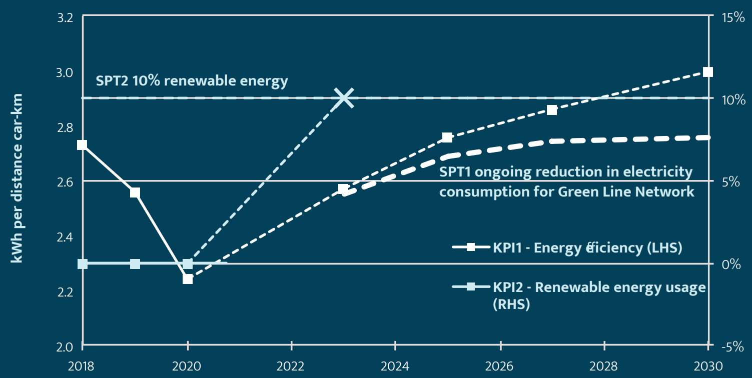
**BOND: BTSTB THB2.95% 11/24 (TH0221A34B06), BTSTB THB4.7% 11/32 (TH0221A3CB04) AND MORE**

In November 2022, Thailand's BTS Group issued a THB20bn multi-tranche SLB. The coupons range from 2.95% for the 2-year to 4.7% for the 10-year tranches. There are 4.5- and 7.5-year tranches as well. The bonds are reported to have achieved 20-25bps savings against conventional bonds.

The two SPTs linked to this SLB are i) SPT1: an improvement in energy efficiency in the Green Line network (an elevated metro rail line in Bangkok) of 8% from business-as-usual (BAU) within nine years (by 2031), and ii) SPT2: the production or procurement of electricity from renewable energy sources equivalent to at least 10% of the annual total electricity used in the operation of the Green Line network.

The new SLB does not include a coupon adjustment. If either SPT is missed, BTS will buy additional REC for the lifetime of the bond for value 0.1% of notional.

Using an average price of USD5/MWh we estimate this to be worth 4.9% of the total 10y energy generation of the Green Line.




**Case table 37.1** Comparison of Kajima emissions reductions between SLB target and purchased offsets. Source: AFII, Kajima

## 4.8 WEAK SPTS AND GREENWASHING RISKS

Inappropriately low sustainability performance targets can damage the integrity of SLBs and expose issuers to accusations of greenwashing. As discussed in Chapter 1, there has been no shortage of accusations of greenwashing towards the SLB sector, some relevant and some originating from a misunderstanding or misperception of the structure.

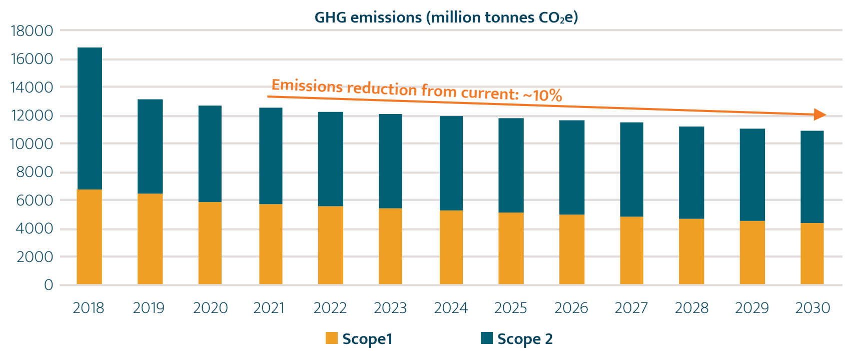
AFII recognises three main types of greenwashing in the SLB sector: weak "participation trophy" targets, misleading targets and metrics, and outright omissions of relevant green or 'grey' data. Omission of data is not further discussed here, please refer to Case study 27, Chapter 4.

"Participation trophy" targets refer to those that the issuers are likely to meet 'just by showing up', but still try to claim have additionality. Enbridge, a major player in the carbon-intensive oil sands industry, printed a structure[15] in 2021 that seemed to fall short of demonstrating a genuine commitment to environmental sustainability.[16] The issuance was structured around three SPTs – two social and one environmental. The latter target was a 35% reduction of Scope 1 + 2 emissions by 2030, using a baseline of 2018, as illustrated in Figure 4.1.

The use of this baseline is problematic, as Enbridge already reduced its Scope 1 + 2 emissions 25% between 2019 and 2020, meaning it needed only to cut emissions by roughly 1% per annum for the next decade in order to achieve its target. Similarly, the social KPIs, including achieving a 40% female representation on the board and increasing workforce diversity to 28% by 2025, are reachable with minimal effort. This painted a picture of low ambition, such that the company was all but guaranteed to avoid incurring any financial penalties from failing to meet its SLB targets.

Misleading targets and/or metrics occur when a structure is designed in such a way that the issuer can have control over the outcome, or manage data, in a way that is opaque to even those investors spending substantial time on due diligence. The Repsol petrochemical carbon storage calculation in Case 21 in the previous chapter is one example of misleading targets in action.

**Figure 4.1** Projected emission reduction pace required from Enbridge to achieve the SLB KPI




SOURCE: Enbridge, AFII calculations

[15] The bond was issued as ENBRIDGE CAD 3.1% 09/2033 (ISIN CA29251ZBU09)

[16] "Enbridge oil sands SLB– participation trophy alert", AFII, 23 Jun 2021.

One way for an issuer to appear to be having an impact while doing little is to conflate real and nominal variables in the SPTs. To take the example of carbon intensity reduction, at a 2% inflation rate, the issuer should see a 9.4% carbon intensity reduction according to the simple formula:

$$\frac{1}{(1+\pi)^T} - 1$$

where $\pi$ is the inflation rate over $T$ years. We plot this relationship for various inflation rates in Figure 4.2. With the traditional effects of compound interest, we can see that expressing carbon intensity in nominal terms in economies running 5% inflation rates gives a tailwind of 39% over a ten-year period.

Case 38 illustrates this, where a real variable – emissions – in the numerator of the SPT is mixed with a nominal variable – EBITDA – in the denominator in the carbon intensity calculation.

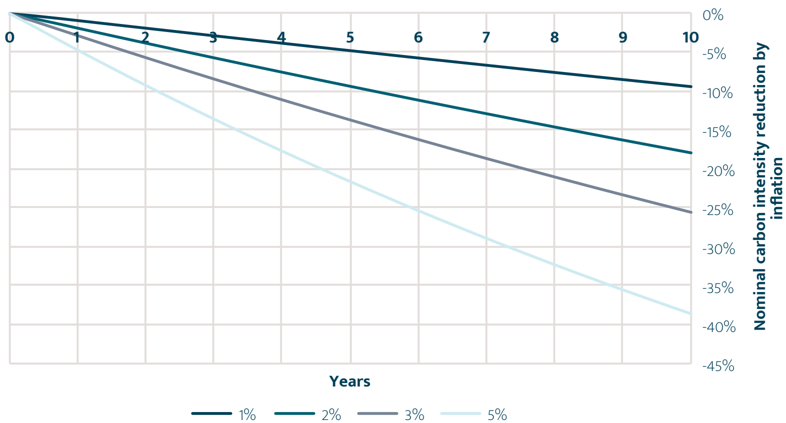
The potential for misleading targets and metrics means an SLB investor should be reasonably critical when evaluating a deal. Transactions are consensual between professional parties, whereas the greenwashing debate often takes on a tone of issuers fooling investors, which does not reflect our experience of the market.

It may also be that greenwashing happens at the intersection of investment (managers) and fiduciaries: an asset manager may represent the investment book as more impactful than it really is to end-investors. Again, this is not a case of issuers fooling investors.

As a final comment on greenwashing, there should be a certain degree of understanding that target setting and pricing are complex topics and that the market is quite new. Thus, some of the SLB greenwash accusations may be aimed at best-effort cases where there simply has not been enough support in terms of methodology or data. It is debatable whether such incidences qualify as genuine greenwashes.

As an example, callability of SLBs has been used to project endemic greenwashing in the market, but when properly analysed – as we attempt to do in Chapter 6 – does not seem to be a relevant conjecture except in a few isolated cases. Indeed, an excessive use of the "greenwashing" term could prove counterproductive by muting innovation in the SLB space.

**Figure 4.2** Carbon intensity reduction (e.g. emissions / USD sales) at given inflation rates



# CASE STUDY 38
## REVENUE-BASED SPTS : ADANI ELECTRICITY

**RESEARCH: ADANI'S SLB: LIKELY TO MEET ITS WEAK TARGETS, FEB 2024**

**BOND: ADANEM USD3.867% 07/31 (XS2367109803)**

AEML's SLB defines emission intensity as: 'tCO₂e (Scope 1 + Scope 2) / EBITDA (in INR in Crore).' EBITDA is an unusual metric to use for the standardisation of emissions. It is not one of the commonly used metrics highlighted for emission intensity by the Partnership for Carbon Accounting Financials (PCAF) or the Task Force on Climate-related Financial Disclosures (TCFD). Revenue is more common and is used by Adani in other Group targets, and we generally regard physical intensity as the most appropriate (emissions per unit output, e.g., $tCO_2e$/MWh, $tCO_2e$/tonne product produced). As noted in the SPO (Second Party Opinion), ICMA's suggested KPI for power sector emissions at the time of Adani's SLB issue was Scope 1 + 2 'carbon intensity per MWh or absolute'.

In addition to being unusual (or potentially even unique), the use of EBITDA in an SLB emission intensity target is inappropriate for two reasons. Firstly, the scope for EBITDA to be managed by issuers (especially those with complex corporate structures), and secondly, its exposure to inflation, which in India is currently elevated.

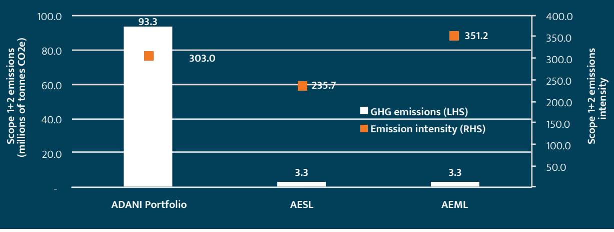
| SCENARIO FY24-FY29 SPT TEST | REQUIRED CHG. IN SCOPE 1+2 EMISSIONS PER YEAR |
|---|---|
| EBITDA rising in line with long-term average inflation (5.2%) | -2.2% |
| EBITDA rising in line with its FY19- growth (9.4%) | 1.8% |

**Case table 38.1** Future scenarios for AEML's EBITDA and implications for KPI-2, emission intensity. Source: AFII

| MEASURE | FY19 BASELINE | FY23 | % CHANGE '19-'23 | CAGR'19-'23 |
|---|---|---|---|---|
| Scope 1+2 GHG $tCO_2e$ (000s) | 3,750 | 3,310 | -11.7% | -3.1% |
| EBITDA (INR in Crore) | 1,664 | 2,381 | 43.1% | 9.4% |
| Emissions intensity – SPT definition ($tCO_2e$ / EBITDA INR in Crore) | 2,254 | 1,390 | -38.3% | -11.4% |
| Operating measures in distribution (Index, FY19=100)* | 100 | 111.6 | 11.6% | 2.8% |
| Physical emissions intensity ($tCO_2e$ / indexed operating measures*) | n.m. | n.m. | -20.9% | -5.7% |

*Index reflects averaged growth in five physical indicators; i) the number of power transformers; ii) number of distribution transformers; iii) power capacity; iv) distribution capacity; v), line length. FY19-23 CAGRs for these variables range from 1.4%-4.7%

**Case table 38.2** Historic emissions intensity calculations for AEML: Contrasting the SLB KPI to physical emissions intensity. Source: AEML, AFII




**Case figure 38.3** Emission comparison across Adani Group for FY23. Source: Adani, AFII

## 4.9 TARGET SETTING CASE STUDY: CHEMICALS SECTOR[17]

As a broader study of target setting, this section reviews issuance of SLBs in the chemical sector in the context of their SPTs. The chemicals sector sits at the nexus of global business. It is an essential part of the supply chains of multiple industries including agriculture, construction, and transport. 95% of manufactured goods rely on chemicals in some capacity.[18]

The chemicals sector is the third-largest industrial emitter of direct $CO_2$ emissions, behind only the steel and cement industries.[19] Responsible for 5.8% of global GHG emissions,[20] it is the world's largest industrial energy consumer, consuming fossil fuels as a 'feedstock' for products such as plastics and fertilisers, as well as using them as a direct energy source.

Its future is intertwined with the fossil fuel industry. With the IEA projecting that petrochemicals will account for 60% of oil demand growth in the current decade,[21] chemicals present an unfortunate opportunity for oil companies to maintain demand even as the energy transition puts pressure on their traditional revenue streams.[22] The emissions from many of these petrochemical products will only be realised at the end of their lives (as plastics are incinerated, for example),[5] contributing to the sector's high Scope 3 impact at 77% of total emissions.[23]

The sector's environmental issues go beyond greenhouse gases, with UNEP-WCMC's ENCORE tool noting a range of problem areas including water use, non-GHG air pollutants, water pollutants, soil pollutants, and solid waste.[24]

Given the footprint of the sector,[25] it would be encouraging to see a strong volume of labelled debt issuances that support companies' transition plans, both in terms of GHG emissions as well as other nature impacts. However, with less than 5% of the sector's debt being issued in the Green, Social and Sustainable (GSS) or sustainability-linked format, the volume is lower than some other sectors, for example utilities where 21% of bonds outstanding are GSSS+ labelled (as of Feb 2023).

### 4.9.1 SECTOR TRANSITION PATHWAY

As shown in Figure 4.3, emissions from the chemical sector are projected in the Net-Zero Emissions by 2050 Scenario (NZE)[26] to reduce modestly by 2030, before falling more rapidly for the following decades.[27] The IEA notes that almost 80% of the emissions savings by 2030 in this sector are reliant on technologies already existing in the market.[15] Beyond this date, however, reductions will be reliant on the use of technologies still being developed, highlighting the need for further investment and innovation in the space.

Figure 4.3 indicates that even if all aspirational targets are met (Announced Pledges Scenario), the 1.5ºC world represented by the NZE will still be missed by a considerable margin, while if it follows the trajectory implied by current policy settings, the emissions of the sector will in fact grow.

[17] This section was originally published as "Chemicals sector: synthesising impact with SLBs", AFII, 13 Jul 2023.

[18] "The Global Chemical Industry: Catalyzing Growth and Addressing Our World's Sustainability Challenges", Oxford Economics, 11 Mar 2019.

[19] "How the chemicals industry's pollution slipped under the radar", The Guardian, 22 Nov 2021.

[20] "Europe turns up heat under chemicals industry to clean up its climate act", Reuters, 7 Feb 2023.

[21] "World Energy Outlook 2020", IEA, Oct 2020.

[22] "Why the future of oil is in chemicals, not fuels", Chemical & Engineering News, 20 Feb 2019.

[23] "Running Hot: Accelerating Europe's Path to Paris", CDP, March 2021.

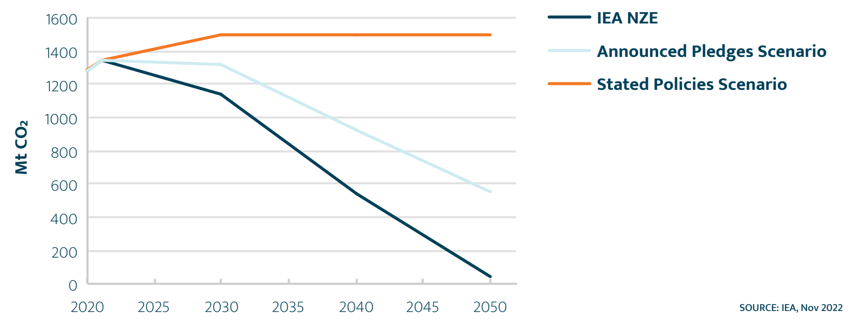
[24] "Exploring Natural Capital Opportunities, Risks and Exposure", UNEP, 2023.

[25] For a comprehensive analysis of the role of petrochemicals in benchmark credit exposure please see "Petrochemicals: Major credits, carbon risks, green bonds", AFII, 10 May 2021.

[26] "Net Zero by 2050", IEA, May 2021.

[27] "World Energy Outlook 2022", IEA, Nov 2022.

**Figure 4.3** IEA emission pathways for chemicals sector




Chemicals have a significant role to play in the climate transition, as they are key to the technologies that will drive change. Chemical products are needed for coating solar modules, ensuring the durability of wind turbines, and as a component of electric vehicle batteries. The strategic importance of the industry is made clear by the European Union's Transition Pathway statement,[28] which notes that it is central to Europe's major value chains, and to the bloc's green and digital 'twin transition'. The chemicals industry is projected to increase its material production under the NZE with global demand for primary chemicals rising 30% by 2050.[29]

**The chemicals sector is an essential component of the economy, lying at the heart of most industries' value chains and with one of the largest environmental impacts. With a significant opportunity ahead for greater green debt issuance, the chemicals industry has the as-yet-unrealised potential to play a major role in supporting the transition.**

### 4.9.2 OVERVIEW OF SLB ISSUANCES IN SECTOR

Twenty-six SLBs have been issued in the chemicals sector between 2021 and 2023, of which 21 are still outstanding.[30] Altogether they represent over USD9.6bn in principal. The vast majority were issued in hard currencies by high-yield and non-rated issuers. Only 13 bonds had publicly available information regarding their KPIs and SPTs, a symptom of the lack of transparency in the fixed income market, and our analysis focused on these issuances.

Investment grade issuers account for almost half of the global SLB market,[1] but there are only two two-tranche high-grade issuances in the chemical sector. Out of the largest 15 issuers, of which 14 are investment grade, none have tapped the SLB market, while five have issued green bonds (see Table 4.6). Our earlier analysis of SLB issuance suggests that in the "Basic Materials" sector (in which "Chemicals" is classified), we have typically seen very little green bond issuance relative to SLB issuance.[1,31]

[28] "Transition pathway for the chemical industry", European Union, Jan 2023.

[29] "Net Zero by 2050", p. 122, IEA, May 2021

[30] For the scope of this chapter, we selected bonds with an issuer BICS Level 2 (Industry Group) classification of "Chemicals" according to Bloomberg as of 25 May 23. All five bonds with zero notional outstanding are schuldschein issuances, bilateral loan agreements unique to the German market, which seem to have been re-paid.

[31] For a full analysis of the BASF green bond please see our earlier work.[11]

**Table 4.5** SLBs in the chemicals sector. Source: Bloomberg, AFII, 13 Jun 2023

| ISSUER | ISIN | ISSUE DATE | MATURITY | CURRENCY | AMOUNT OUT-STANDING (USDBN) | COMPOSITE RATING |
|---|---|---|---|---|---|---|
| ARAKAWA CHEMICAL INDUSTRIES LTD | JP312500AMB9 | 26-NOV-21 | 26-NOV-26 | JPY | 0.0 | N.A. |
| BRASKEM IDESA SAPI | US10554NAB47 | 20-OCT-21 | 20-FEB-32 | USD | 1.2 | B+ |
| FIS FABBRICA ITALIANA SINTETICI SPA | XS2436585355 | 10-FEB-22 | 01-AUG-27 | EUR | 0.4 | B |
| HERENS HOLDCO SARL | US427169AA59 | 14-MAY-21 | 15-MAY-28 | USD | 0.4 | B- |
| HERENS MIDCO SARL | XS2340137343 | 14-MAY-21 | 15-MAY-29 | EUR | 0.5 | CCC |
| INDORAMA VENTURES PCL | TH102703C509 | 03-NOV-21 | 03-MAY-32 | THB | 0.1 | N.A. |
| INDORAMA VENTURES PCL | TH1027038B08 | 03-NOV-21 | 03-NOV-28 | THB | 0.1 | N.A. |
| INDORAMA VENTURES PCL | TH1027036B00 | 03-NOV-21 | 03-NOV-26 | THB | 0.1 | N.A. |
| ITELYUM REGENERATION SPA | XS2389112736 | 01-OCT-21 | 01-OCT-26 | EUR | 0.6 | B |
| LANXESS AG | XS2415386726 | 01-DEC-21 | 01-DEC-29 | EUR | 0.6 | BBB |
| LANXESS AG | XS2459163619 | 22-MAR-22 | 22-MAR-28 | EUR | 0.6 | BBB |
| LUNE HOLDINGS SARL | XS2406727151 | 18-NOV-21 | 15-NOV-28 | EUR | 0.5 | B |
| NAGASE & CO LTD | JP364780AN64 | 09-JUN-22 | 09-JUN-32 | JPY | 0.1 | N.A. |
| NOBIAN FINANCE BV | XS2358383466 | 01-JUL-21 | 15-JUL-26 | EUR | 0.6 | B |
| ORBIA ADVANCE CORP SAB DE CV | US68560EAB48 | 11-MAY-21 | 11-MAY-31 | USD | 0.5 | BBB- |
| ORBIA ADVANCE CORP SAB DE CV | US68560EAA64 | 11-MAY-21 | 11-MAY-26 | USD | 0.6 | BBB- |
| ORBIA ADVANCE CORP SAB DE CV | MX91OR010021 | 08-DEC-22 | 25-NOV-32 | MXN | 0.4 | N.A. |
| ORBIA ADVANCE CORP SAB DE CV | MX91OR010013 | 08-DEC-22 | 04-DEC-25 | MXN | 0.1 | N.A. |
| RED SURCOS SA | ARREDS5600D5 | 08-JUN-22 | 08-JUN-24 | USD | 0.0 | N.A. |
| XINJIANG ZHONGTAI CHEMICAL CO LTD | N/A | 22-MAR-23 | 22-MAR-28 | CNY | 0.1 | N.A |

**Table 4.6** Top 15 issuers in the Chemical sector, and green bonds. Source: Bloomberg, 13 Jun 2023

| ISSUER | TOTAL BONDS OUTSTANDING (USDBN) | GREEN BOND |
|---|---|---|
| BASF SE | 18.1 | Y |
| LINDE PLC | 14.8 | N |
| DOW CHEMICAL CO/THE | 13.3 | N |
| CELANESE US HOLDINGS LLC | 12.0 | N |
| AIR LIQUIDE FINANCE SA | 11.0 | Y |
| LYB INTERNATIONAL FINANCE III LLC | 9.8 | Y |
| SHERWIN-WILLIAMS CO/THE | 9.6 | N |
| INTERNATIONAL FLAVORS & FRAGRANCES INC | 9.2 | N |
| ECOLAB INC | 9.1 | N |
| NUTRIEN LTD | 8.8 | N |
| DUPONT DE NEMOURS INC | 8.2 | N |
| AIR PRODUCTS AND CHEMICALS INC | 7.0 | Y |
| LG CHEM LTD | 6.0 | Y |
| SASOL FINANCING USA LLC | 5.6 | N |

The absence of large issuers in the SLB market raises two points of potential concern. Firstly, investors wanting to invest in SLBs may be required to underweight the chemicals sector due to limited investment options.[32] Second, reducing the largest companies' environmental footprint in absolute terms is critical for the sector to meet its net-zero and nature-related goals. Green bonds are successful at raising capital for specific sustainable investments,[33] but do not necessarily affect the issuer as a whole. Ambitiously structured SLBs can align large issuers' entire corporate structure with strong sustainability targets, and so have a substantial impact and provide investors with enhanced transparency.

**SLBs can be an impactful structure for raising capital for the low-carbon transition. Chemical sector companies have the potential to use this product to align their capital structures with ambitious sustainability plans and accelerate their climate transitions.**

### 4.9.3 SECTOR KPIS: A NEED FOR FURTHER DIVERSIFICATION

As discussed earlier, when assessing the impact of SLBs it is essential to consider the relevance and ambition levels of KPIs, as well as the materiality of the step structures utilised.

This section provides analysis of these SLB characteristics in issuances from chemicals companies.

The chemical sector's environmental footprint is not only limited to GHG emissions, with companies also having an impact on water, soil, and non-GHG air pollutants, depending on the specific products of the company in question.[10] Despite this, the ICMA registry of KPIs for SLBs only has one KPI specific to the chemicals sector, relating to the production of green hydrogen.[34] There are, however, a number of 'general' KPIs listed by ICMA which can be applied to the business practices of chemicals companies. Table 4.7 is a condensed summary of the SPTs used in the chemicals sectors, mapping SPTs to categories of KPIs. We have mapped these KPI themes against ENCORE impact drivers and materiality ratings.[10,35] ENCORE is a tool developed by the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) aiming to help financial institutions understand and integrate natural capital risks in their operations.

As Table 4.7 indicates, the most common KPI category for SLBs in the chemicals sector relates to absolute GHG emissions (Scope 1 + 2). The preponderance of absolute targets

**Table 4.7** Categorised KPIs used by issuances from chemicals companies. Source: AFII

| KPI THEME | ENCORE IMPACT DRIVER | ENCORE MATERIALITY RATING | BONDS WITH THEME |
|---|---|---|---|
| ABSOLUTE GHG (SCOPE 1+2) | GHG EMISSIONS | HIGH | 8 |
| RENEWABLE ENERGY USAGE | GHG EMISSIONS | HIGH | 4 |
| GHG INTENSITY (SCOPE 1+2) | GHG EMISSIONS | HIGH | 3 |
| PLASTIC RECYCLING | SOLID WASTE | HIGH | 3 |
| ABSOLUTE SOX | NON-GHG EMISSIONS | MEDIUM TO HIGH | 2 |
| WASTE DISPOSAL / RECOVERY | SOLID WASTE | HIGH | 2 |
| WATER CONSUMPTION | WATER USE | HIGH TO VERY HIGH | 1 |
| ABSOLUTE GHG EMISSIONS (SCOPE 3) | GHG EMISSIONS | HIGH | 1 |
| AVOIDED GHG EMISSIONS FROM PRODUCT | GHG EMISSIONS | HIGH | 1 |

[32] This is already the case for the corporate green bond market where financial institutions and utility companies make up most of the issuances. See "How green bonds fit in a fixed income portfolio", Goldman Sachs AM, 20 Feb 2023.

[33] For an example see "Thames Water green bonds: all in the same puddle", AFII, 4 Jul 2023.

[34] "Sustainability-Linked Bonds Illustrative KPIs Registry", ICMA, Jun 2022.

[35] ENCORE provides a list of impact drivers for specific sectors & sub-industries (a 2023 version is also available) as well as a materiality rating from very low, indicating a small and infrequent impact, to very high, indicating a large and continuous impact. More information can be found on the ENCORE website. Impact drivers are defined in accordance with the Natural Capital Protocol (2016) as a measurable quantity of a natural resource that is used as an input to production, or as a measurable non-product output of business activity. ENCORE splits chemicals into four sub-industries: commodity chemicals, diversified chemicals, fertilizers & agricultural chemicals, and specialty chemicals. In Table 4.7 we have provided the range where materiality ratings varied for different chemical sub-industries.

over intensity targets is positive, and as shown in Appendix 1, these targets seem ambitious when compared with the IEA NZE pathway, which targets a fall in $CO_2$ emissions of -11.7% by 2030 from 2020 (see Figure 4.3). Given the level of diversity inherent in chemicals sector businesses, it is important that clear indications are provided in sustainability-linked frameworks highlighting which pathway to decarbonisation the targets are consistent with – for example the IEA NZE – or if the targets have been certified by the SBTi or another standard setter.[36]

The SBTi is currently developing sector-specific guidance and sectoral decarbonisation approach (SDA) pathways for the chemicals sector, however companies can already set targets according to the cross-sectoral absolute contraction approach (ACA). Of the 14 issuers with SLBs outstanding, only four have either committed or set a near-term target, whilst only one has committed to a net-zero target through the SBTi.[37]

We find that only one SLB (NAGASE 0.64 06/09/32) targets Scope 3 emissions as a KPI. Although companies are still developing their capacities to record and address Scope 3 emissions, they are an essential part of their transitions, and including them as a KPI would send a positive signal of ambition. The SBTi criteria for near-term targets state that in cases where the Scope 3 emissions of a company are in excess of 40%, they must be included in near-term targets.[38] The CDP notes that Scope 3 emissions account for more than 77% of the total GHG emissions in the chemicals sector,[9] indicating the need to include these emissions in the transition plans and thus KPIs of chemicals companies.

Including Scope 3 emissions in SLBs would also encourage companies to clearly disclose the ways in which they are measuring and achieving Scope 3 emission reductions, as well as help to ensure that creative carbon accounting cannot be used to avoid paying a step-up. An example of this is Nobian,[39] where municipal waste incineration (MWI) may have been taken advantage of to reduce Scope 1 + 2 emissions without a clear indication of whether this was then included in the company's Scope 3 emissions. The SLB referenced only Scope 1 + 2 emissions, meaning a reclassification potentially moved emissions out of inclusion of the SLB KPI.

The large majority of KPIs in the sector are related to GHG emissions, and although it is necessary that GHG emissions (preferably including Scope 3) be included in the KPIs of these bonds, integrating additional, more diversified, KPIs relevant to individual companies would strengthen issuances. From the set of SLBs where KPI information was available in SLB documentation, only one included a KPI relating to water, and that one targeting water consumption rather than a reduction in pollution. As evidenced by recent court settlements,[40] the environmental damage caused by chemicals companies via water pollution among other impacts, shows how these issues can quickly become financially relevant.

**The diversification of KPIs, with greater inclusion of Scope 3 emissions and adoption of nature-based metrics, will be key for the chemicals sector to align with credible transition plans. The industry's complexity calls for heightened reliance on scientifically validated targets for ensuring clearly defined emissions pathways.**

[36] "Barriers, Challenges, and Opportunities for Chemical Companies to Set Science-Based Targets", Science Based Targets, Dec 2020.

[37] SBTi defines near-term targets as outlining "the amount by which organisations will reduce their emissions, usually over the next 5-10 years" whilst net-zero targets "indicate the degree of emissions reductions organisations need to achieve across all emissions scopes to align with net-zero no later than 2050". SBTi's Target Dashboard (Beta) was used to check which companies and institutions have set science-based targets.

[38] "SBTi Criteria and Recommendations for Near-Term Targets", SBTi, Apr 2023.

[39] "Nobian SLB: a lot of hot air?", AFII, 16 May 2023.

[40] See "Companies to pay billions in "forever chemical" water pollution settlements", Axios, June 2023 and "Tears and protests as judge approves settlement over 'forever chemicals'", The Sydney Morning Herald, June 2023, for two examples of recent cases.

### 4.9.4 STEP STRUCTURES: LIMITED FINANCIAL MATERIALITY

The SLB market has attracted criticism, in part for the prevalence of small step-ups which may provide little incentive for issuers to improve their sustainability performance.[41] The chemicals sector is no exception, with issuers paying 23.7bps step-ups on average for missing an SPT, which is consistent with the tendency of the SLB market to set these step-ups at 25bps.[42] Such step-ups appear marginal against a backdrop of ECB and Fed 'risk-free' interest rates of 4% and 5-5.25%, respectively.

Table 4.8 provides information on the step-structures of the nine SLBs in the sector where this information is publicly available.[43] Coupon step-ups are the most common form of payment structure, which can take the form of an increased running coupon or a premium payment at maturity. Maximum payment equals the total cumulative step-up if all SPTs are missed. One SLB from Nagase was excluded from this table as emissions credits are purchased in the event of missing an SPT.[44]

Using AFII's greenback methodology, (see section in Chapter 2 for more detail) we evaluate the materiality of the step structures. We find that no SLB in the chemicals sector meets the definition of a greenback SLB, an observation that currently holds true across most of the SLB universe. Omitting discount factors, bonds in scope would need their step-ups to increase two- to four-fold to meet AFII's greenback criteria.

**SLBs have the potential to drive transition when structured to incentivise a material improvement in the issuers' sustainability performance. An option-based pricing approach[45] should reward ambition and material structures with attractive pricing spreads.**

### 4.9.5 KEY CONCLUSIONS ON CHEMICALS SECTOR SLBS

The chemicals sector is a significant user of fossil fuels, both as an energy source as well as a feedstock for a range of petrochemical products such as plastics and fertilisers.[46] It is also a significant polluter of water, air, and soil. Transforming the chemicals sector into a sustainable industry would offer significant benefits both in terms of emissions and other direct impacts on the environment. Due to its role in global manufacturing, it would also enable a variety of downstream industries to operate more sustainably.

SLBs are a powerful tool to raise capital for this transition, both to scale up existing

**Table 4.8** Chemical SLB materiality assessment. Source: Bloomberg, individual bond documentation, AFII

| ISSUER | BOND | TENOR (YEARS) | CCY | MAXIMUM PAYMENT (BPS) | GREENBACK SLB |
|---|---|---|---|---|---|
| LUNE HOLDINGS SARL | KEMONE 5 5/8 11/15/28 | 7 | EUR | 75 | NO |
| LANXESS AG | LXSGR 1 3/4 03/22/28 | 6 | EUR | 62.5 | NO |
| NOBIAN FINANCE BV | NOHOLB 3 5/8 07/15/26 | 5 | EUR | 100 | NO |
| LANXESS AG | LXSGR 0 5/8 12/01/29 | 8 | EUR | 100 | NO |
| FIS FABBRICA ITALIANA SINTETICI SPA | FISITA 5 5/8 08/01/27 | 5 | EUR | 60 | NO |
| BRASKEM IDESA SAPI | BAKIDE 6.99 02/20/32 | 10 | USD | 112.5 | NO |
| ORBIA ADVANCE CORP SAB DE CV | ORBIA 2 7/8 05/11/31 | 10 | USD | 125 | NO |
| ORBIA ADVANCE CORP SAB DE CV | ORBIA 1 7/8 05/11/26 | 5 | USD | 50 | NO |
| ITELYUM REGENERATION SPA | ITLYUM 4 5/8 10/01/26 | 5 | EUR | 60 | NO |

[41] "Sustainability bond market stumbles as investors get picky", Financial Times, 14 Feb 2023
[42] "Do Sustainability-linked bonds have a step-up problem?", Federated Hermes, Mar 2022.
[43] Only nine SLBs in the universe considered had available information on their step-structures.
[44] For further details on these alternative step structures please see "Sustainability-Linked Bonds: alternative steps", AFII, 23 May 2023.
[45] See for practical applications "An option pricing approach for sustainability-linked bonds", AFII, 8 Nov 2022.
[46] "The Future of Petrochemicals", IEA, Oct 2018.

technologies and assist innovation for new solutions. If structured ambitiously, SLBs can provide a hedge for investors against poor sustainability performance and attractive funding costs for issuers.

**Our analysis suggests SLB issuance in the chemicals sector is lagging other hard-to-abate sectors. It would be encouraging to see more issuers considering this product, and more investors to express appetite for well-structured SLBs.**

With that in mind, we present three recommendations for how to structure SLBs in the chemicals sector for maximum impact:

- **Targets need to be scientifically verified for credibility.** As businesses within the sector vary greatly, comparability without this is hard.
- **Diverse KPIs should be used.** The climate impact of the chemicals sector goes beyond emissions, and so meaningful KPIs should be chosen that represent all environmental impacts.
- **Structures should be material, with meaningful step structures.** The AFII greenback methodology offers a guide on financial materiality which would support higher option values, and therefore tighter funding spreads for issuers.

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# 05

# SLB PRICING WITH CREDIT RISK AND STOCHASTICS

# 05 SLB PRICING WITH CREDIT RISK AND STOCHASTICS

## SECTIONS



## CASE STUDIES

# "There is growing evidence that there is an empirical relationship between credit risk and the sustainability profile of an issuer"

## 5.1 CREDIT RISK IN A SUSTAINABILITY CONTEXT[1]

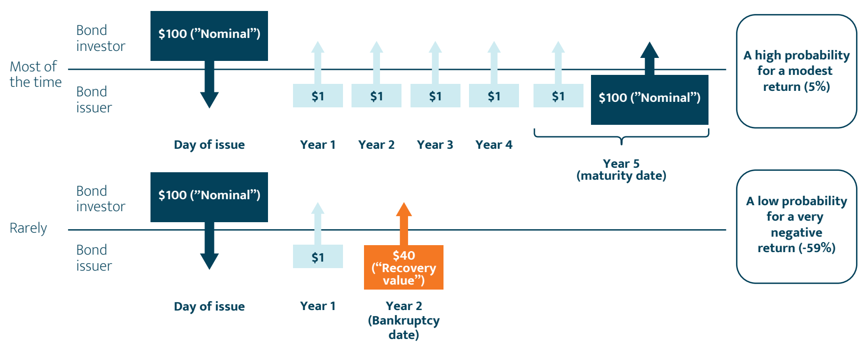
The pricing framework in Chapter 2 assumes that both the EVB and SLB cash flows are risk-free, i.e. that there is zero risk of non-repayment of principal and coupon. However, credit risk is an indelible feature of bonds and has to be reflected in pricing. In primary markets, a bond with higher credit risk will need to pay a higher coupon, reflecting the risk of outsized negative returns.

Moreover, going by the literature there is growing evidence that there is an empirical relationship between credit risk and the sustainability profile of an issuer.[2] This being the case, it may be assumed that *everything else being equal* an SLB issuer that achieves its SPTs will have less credit risk than had it not achieved them. As we argue in Chapter 3, one of the main motivations for using SLBs is this correlation between credit risk and sustainability performance risk. Indeed, this is what makes the instrument an effective risk-hedge.

The correlation can be direct/causal or indirect/have a signalling effect. Either achieving the targets genuinely improves the issuer's financial risk profile, or it indicates to the market the competence of the issuer's management, which has an effect on perceptions of its risk profile.

This chapter will explore two aspects of pricing in the context of this dynamic. First, we will break down SLB pricing with reference to credit risk and contingent pricing risk, as per the option pricing approach discussed earlier. Second, we will translate the discrete period pricing model into a continuous time version, using the Black-Scholes methodology.

**Figure 5.1** Bond coupons generate returns over risk-free rates in the positive case (high probability, no default) to compensate for the negative returns in the adverse case (low probability, default and recovery)




[1] Sections 5.1-5.3 were originally published in "Notes on Risk-Neutral Pricing of SLBs and Step-down Structures", AFII, Oct 2022 and "Contingent Resilience-Linked (Corl) Bonds: Combining Public and Private Capital for Resilience", AFII, Dec 2023

[2] See, for example, "Are Sustainable Companies More Likely to Default? Evidence from the Dynamics between Credit and ESG Ratings" Aslan, Poppe and Posch (2021).

### 5.1.1 PRICING BONDS USING RISKY DISCOUNT CURVES

The concept of discount curves is ubiquitous in finance but is not always considered when it comes to making decisions on sustainable investments.

The basic principle is that future cash flows are valued according to some discount curve; in the risk-free world, it is – or should be – obvious that an annual fixed-rate cash flow of 4% for 10 years is more valuable if the risk-free rate is 1% than if it is 5%.

Discount rates can also be adjusted to account for expected default risks and other risk premiums. This is what we call risky discount curves, illustrated in Table 5.1. The most common way to incorporate default risk in discounting curves is to use credit ratings: a BBB-rated bond should be discounted using a BBB discount curve, and so on. As we can see in Table 5.1, the discount factor for the BBB-rated bond for a 10-year payment is 1.784 versus 2.067 for the BB-rated risk. In other words, a USD4 coupon payment in year ten is worth USD2.24 in net present value terms if the underlying risk is BBB-rated, and USD1.94 if it is BB-rated.

This implies that investors can price in anticipated credit rating deteriorations or improvements in bond prices by applying risky discount curves. If an investor believes a BB-rated bond will improve in terms of creditworthiness, then applying a BBB discount curve will assign it a higher valuation than that reflected by the market. This in turn should motivate the investor to buy the bond today at the lower market price, in anticipation of future gains as the issuer's creditworthiness improves.

Risky discount curves are of course time-varying, both as underlying risk-free rates change and – more importantly – as the risk perception between credit rating categories shifts. The data in Figure 5.2 illustrates this variability, using average yields dating back to 1996.

It is important to note that spreads between rating categories do not follow a linear pattern. For example, the difference between the AAA and AA rating change in terms of spreads is much lower than that between BBB and BB. This goes back to the definition and calibration of credit ratings versus default probabilities, where ratings are based on exponential, rather than linear, increases.

Table 5.2 shows this numerically: the incremental change in spreads sits at 32.5bps when moving from AA to A, whereas it is almost 160bps when going from BBB to BB. The right-hand panel of the table shows the large increases in default probabilities as one moves between letter grades. For example, a BBB rating implies a 5-year default rate of 2.6% and a BB rating a default rate of 8.3% – more than three times higher.

**Table 5.1** Spot rates and (risky) discount curves, August 2023. Source: Bloomberg, AFII

| | SPOT RATES | | | DISCOUNT FACTORS | | |
|---|---|---|---|---|---|---|
| YEAR | AAA | BBB | BB | AAA | BBB | BB |
| 1 | 5.41% | 6.08% | 6.87% | 1.054 | 1.061 | 1.069 |
| 2 | 4.75% | 5.91% | 6.85% | 1.097 | 1.122 | 1.142 |
| 3 | 4.35% | 5.80% | 6.85% | 1.136 | 1.184 | 1.220 |
| 4 | 4.23% | 5.72% | 6.89% | 1.180 | 1.249 | 1.305 |
| 5 | 4.29% | 5.69% | 6.97% | 1.233 | 1.319 | 1.400 |
| 6 | 4.46% | 5.72% | 7.09% | 1.299 | 1.396 | 1.508 |
| 7 | 4.64% | 5.77% | 7.20% | 1.374 | 1.481 | 1.627 |
| 8 | 4.79% | 5.82% | 7.31% | 1.454 | 1.573 | 1.759 |
| 9 | 5.03% | 5.89% | 7.42% | 1.555 | 1.673 | 1.904 |
| 10 | 5.50% | 5.96% | 7.53% | 1.708 | **1.784** | **2.067** |

**Figure 5.2** Average spreads (option-adjusted, OAS) across rating segments based on Bank of America data, FRED-database. 1995-2023

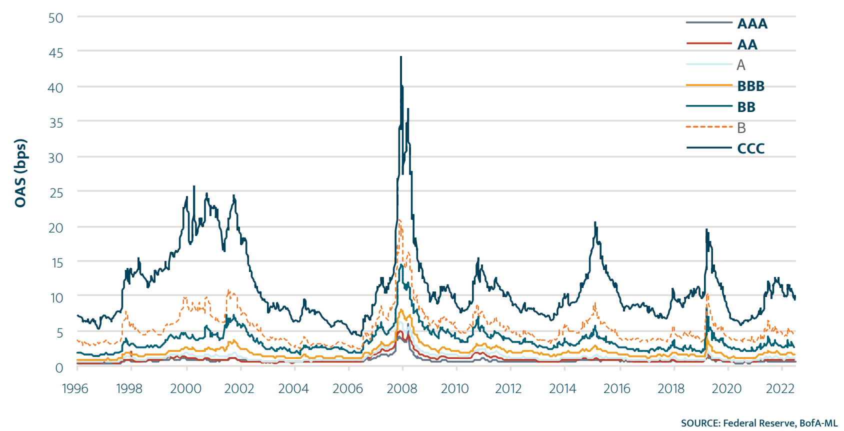



**Table 5.2** Rating categories and average yields and spreads, 1995-2023, not adjusted for maturity; cumulative default rates for rating grades (subsequent ratings post initial rating). Source: FRED, S&P Global Ratings, AFII

| RATING NOTCH | RATING POINTS | AVERAGE OAS | SPREAD OVER AA (BPS) | DELTA (BPS) | CUMULATIVE DEFAULT RATES (S&P)/ BY YEAR 1 | 3 | 5 | 7 | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| AAA | 100 | 0.78 | -18.5 | | - | - | - | - | - |
| AA | 90 | 0.97 | 0.0 | 18.5 | - | 0.1% | 0.1% | 0.2% | 0.5% |
| A | 75 | 1.29 | 32.5 | 32.5 | 0.2% | 0.6% | 0.8% | 0.9% | 2.2% |
| BBB | 60 | 1.97 | 100.1 | 67.6 | 1.6% | 2.1% | 2.6% | 3.2% | 5.2% |
| BB | 45 | 3.57 | 259.9 | 159.8 | 4.0% | 6.8% | 8.3% | 9.3% | 11.9% |
| B | 30 | 5.40 | 442.9 | | 24.6% | 32.5% | 35.1% | 35.6% | 34.7% |
| CCC | 15 | 11.22 | 1025.2 | | 66.4% | 53.0% | 47.7% | 44.9% | 38.7% |
| | | | AVERAGE | 69.60 | | | | | |

Let us now move to an explicit example: we assume a 10-year bond with a fixed annual coupon of 7.25%. This is illustrated in Table 5.3. (on the next page). When we discount the bond with a BB curve, we get a price of 98.892. However, if we use a BBB curve, the price goes up by almost nine points, to 109.89. Effectively, this means that the value to the investor of having a BBB profile on this bond, compared to BB, is approximately ten points (percentage points of the nominal price).

We can go further and calculate the price assuming that the investor anticipates this BB bond will achieve a rating uplift to BBB at some point before it matures. Let's say the investor believes the bond will migrate from a BB to a BBB risk curve after five years. What should the bond price be in that case? This is tabulated in the rightmost panel of Table 5.3, where we can see that the price ends up as 100.56, which is relatively close to the BB-only bond. This is because the default risk is front-loaded. In other words, the incremental risk in the BB bond is concentrated in the first five years (before the bond has assumed a lower BBB default trajectory) and hence the default probability reduction in the backend is relatively slight.

**Table 5.3** Value of a 7.25% coupon bond (simplified) based on BBB and BB, and a split BB/BBB discount curve respectively. Split as BB 0–5y, then BBB 5–10y. USD. as of 25 Aug 2023. Source: AFII, Bloomberg

| | | BBB BOND | | | | BB | | | | BB 1-5Y, BBB 5-10Y | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | COUPON | SPOT RATE | DISC. FACTOR | DISC. COUPON | DISC. NOMINAL | SPOT RATE | DISC. FACTOR | DISC. COUPON | DISC. NOMINAL | SPOT RATE | DISC. FACTOR | DISC. COUPON | DISC. NOMINAL |
| 1 | 7.25 | 6.075 | 1.061 | 6.83 | | 6.87 | 1.069 | 6.784 | | 6.87 | 1.069 | 6.78 | |
| 2 | 7.25 | 5.909 | 1.122 | 6.46 | | 6.85 | 1.142 | 6.350 | | 6.85 | 1.142 | 6.35 | |
| 3 | 7.25 | 5.795 | 1.184 | 6.12 | | 6.85 | 1.220 | 5.943 | | 6.85 | 1.220 | 5.94 | |
| 4 | 7.25 | 5.716 | 1.249 | 5.80 | | 6.89 | 1.305 | 5.555 | | 6.89 | 1.305 | 5.55 | |
| 5 | 7.25 | 5.691 | 1.319 | 5.50 | | 6.97 | 1.400 | 5.177 | | 6.97 | 1.400 | 5.18 | |
| 6 | 7.25 | 5.721 | 1.396 | 5.19 | | 7.09 | 1.508 | 4.807 | | 7.00 | 1.501 | 4.83 | |
| 7 | 7.25 | 5.767 | 1.481 | 4.90 | | 7.20 | 1.627 | 4.455 | | 7.04 | 1.610 | 4.50 | |
| 8 | 7.25 | 5.823 | 1.573 | 4.61 | | 7.31 | 1.759 | 4.123 | | 7.10 | 1.731 | 4.19 | |
| 9 | 7.25 | 5.885 | 1.673 | 4.33 | | 7.42 | 1.904 | 3.808 | | 7.16 | 1.864 | 3.89 | |
| 10 | 7.25 | 5.957 | 1.784 | 4.06 | 56.07 | 7.53 | 2.067 | 3.508 | 48.38 | 7.23 | 2.011 | 3.61 | 49.74 |
| SUM | | | | 53.82 | 56.07 | | | 50.51 | 48.38 | | | 50.83 | 49.74 |
| **BOND PRICE** | | | | | **109.89** | | | | **98.89** | | | | **100.56** |

We can go further and calculate the price assuming that the investor anticipates this BB bond will achieve a rating uplift to BBB at some point before it matures. Let's say the investor believes the bond will migrate from a BB to a BBB risk curve after five years. What should the bond price be in that case? This is tabulated in the rightmost panel of Table 5.3, where we can see that the price ends up as 100.56, which is relatively close to the BB-only bond. This is because the default risk is front-loaded. In other words, the incremental risk in the BB bond is concentrated in the first five years (before the bond has assumed a lower BBB default trajectory) and hence the default probability reduction in the backend is relatively slight.

### 5.1.2 DEFAULT RISK PRICING

Now let us break down how to price this bond using the risky discount curve approach. The bond price $P^{BB}$ (which has the yield $r^{BB}$ as per above) is the risk-free discounted cash flow of coupons plus return of nominal, probability weighted, and the risk-free discounted value of recovery in case of default:

$$P^{BB} = \sum_{t=0}^{T} \phi_i^{rf} \cdot S_t^{BB} \cdot C_t + \sum_{t=0}^{T} \phi_i^{rf} \cdot \Delta(1 - S_t^{BB}) \cdot R + \phi_T^{rf} \cdot S_T^{BB} \cdot N$$

where $\phi_t^{rf}$ is the risk-free discount factor for time $t$, and $S_t^{BB}$ is the survival probability for a BB bond until time $t$, such that $1 - S_t^{BB}$ is the cumulative default probability at time $t$.[3] There is an equivalent BBB-rated bond with price $P^{BBB}$ calculated analogously to the BB bond. We exemplify pricing the same BBB and BB bond structures as before, but using default probabilities based on historical data, in Table 5.4.

[3] SΔ $(1 - S_i^{BB})$ is the marginal default rate ("hazard rate") between time *i* and *i-1*.

**Table 5.4** Pricing BBB and BB bonds using risk-free discount rates and expected losses given by historical default rates and a 40% recovery assumption. Source: AFII

| YEAR | BBB CUM. DEFAULT | DISC. COUPON | EXPECTED RECOVERY | NOMINAL PAY-BACK | BB CUM. DEFAULT | DISC. COUPON | EXPECTED RECOVERY | NOMINAL PAY-BACK |
|---|---|---|---|---|---|---|---|---|
| 1 | 1.0% | 6.809 | 0.379 | | 5.5% | 6.500 | 2.087 | |
| 2 | 1.8% | 6.491 | 0.273 | | 9.4% | 5.989 | 1.403 | |
| 3 | 2.5% | 6.222 | 0.264 | | 13.2% | 5.539 | 1.355 | |
| 4 | 3.1% | 5.952 | 0.203 | | 14.7% | 5.239 | 0.508 | |
| 5 | 3.7% | 5.660 | 0.195 | | 16.2% | 4.925 | 0.486 | |
| 6 | 4.1% | 5.354 | 0.108 | | 16.9% | 4.637 | 0.215 | |
| 7 | 4.4% | 5.044 | 0.102 | | 17.6% | 4.348 | 0.204 | |
| 8 | 5.3% | 4.725 | 0.238 | | 18.6% | 4.058 | 0.284 | |
| 9 | 6.1% | 4.376 | 0.223 | | 19.7% | 3.745 | 0.266 | |
| 10 | 7.0% | 3.947 | 0.203 | 54.446 | 20.7% | 3.366 | 0.242 | 46.426 |
| BPC | | 54.580 | 2.189 | 54.446 | | 48.346 | 7.052 | 46.426 |
| **BOND PRICE** | | | | **111.215** | | | | **101.824** |

There are three distinct valuation differences highlighted in the table:

- **Coupon payouts:** The BBB-rated bond coupon stream is more valuable (in that it contributes 54.58 to the bond price) than that of the BB-rated bond (price contribution 48.346) as it is more likely that the above-risk-free rate coupons will be paid out to the investor.
- **Expected recovery:** Somewhat counterintuitively, the expected values recovered are higher in the case of the BB-rated bond (7.052 vs 2.189 bond price contribution), but this is a function of the recoveries being paid out more often in the BB case, as would be expected given the higher default rate.
- **Nominal pay-back:** This is substantially higher in the case of the BBB-rated bond (54.446 price contribution) versus the BB (46.426) as it is simply more likely the nominal will be fully repaid in the BBB case.

What these differences tell us is that the bond valuation's two primary components are: (i) the likely coupon stream to be received (54.580 vs 48.346, BBB vs BB), and (ii) the valuation of the repayments of notional and recoveries ([54.446+2.189]=56.635 vs [46.426+7.052]=53.478, BBB vs BB).

Looking at the full valuation differential between the BBB- and BB-rated bond of 111.215-101.824 = 9.391, we see that 54.580-48.436=6.234 of that is being driven by the coupon stream, and 56.635-53.478=3.157 is driven by claims to the nominal.

## 5.2 DEFAULT RATES CONDITIONAL ON TRIGGERING OF SLB STEPS

In this example, we assume a step-down SLB (SLBD) with a 75% step probability. We introduce an annual default rate of 2% to reflect the risk that the issuer defaults while the bond is outstanding. However, we further assume that if the issuer achieves its SPT, the default rate reduces to 1.5% per annum. The step-down is 25bps, and the fixed SLB coupon (as well as EVB coupon) is 150bps, with a flat discount curve of 2%.

This example is redolent of a fossil fuel intensive company that sets itself targets over a five-year period to transition its business model. If it is successful, it is likely to be a lower credit risk. We assume a 40% recovery rate in case of default.

Using all these inputs we generate various scenario probabilities, present value (PV) of cash flows, and probability-weighted PVs in Table 5.5 with final bond prices highlighted.

In this set-up, the EVB prices at 102.028 and the SLBD at 102.042, meaning the SLBD is a slightly better value proposition than the EVB, even if the fixed coupon is the same. This reflects how an investor is willing to forgo some amount of return if it believes the SPTs will drive derisking behaviour at the issuer. With the SLB structure, the investor can effectively conditionalise this loss of return on the issuer's achievement of a lower risk profile. This is the core of the sustainability risk/return-correlation approach discussed in Chapter 3.

Analogously, investors can view step-ups as compensation for increased risk versus the baseline if the issuer does not achieve its SPTs. An example is shown in Table 5.6, where we can see that the step-up of 50bps is not sufficiently compensating for an increase in the default rate (from 2% to 3%). This can be a useful context for the statement "investors don't want to get step-ups." In practice, they should want them as they serve as important risk hedges against poor sustainability performance, if set at the appropriate level.

**Table 5.5** Pricing an EVB and step-down SLB with unconditional default rate of 2% per annum, but assuming a 1.5% per annum default rate from year 5 if the sustainability target has been hit (25% probability) for the SLB. 25bps step-down

| YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SCENARIO PROB | 2.00% | 1.96% | 1.92% | 1.88% | 1.84% | 1.81% | 1.77% | 1.74% | 1.70% | 1.67% | 81.71% |
| PV CASH FLOW | 40.000 | 42.647 | 45.242 | 47.786 | 50.281 | 52.726 | 55.124 | 57.474 | 59.779 | 62.038 | 113.474 |
| PROB WEIGHTED | 0.800 | 0.836 | 0.869 | 0.900 | 0.928 | 0.953 | 0.977 | 0.998 | 1.017 | 1.034 | 92.716 |
| EVB CASH PRICE | | | | | | | | | | | **102.028** |
| PROB NO STEP | 2.00% | 1.96% | 1.92% | 1.88% | 1.84% | 0.45% | 0.44% | 0.43% | 0.43% | 0.42% | 20.43% |
| PROB STEP | | | | | | 1.02% | 1.00% | 0.99% | 0.97% | 0.96% | 62.86% |
| PV NO STEP | 40.000 | 42.647 | 45.242 | 47.786 | 50.281 | 52.726 | 55.124 | 57.474 | 59.779 | 62.038 | 113.474 |
| PV STEP | | | | | | 52.500 | 54.675 | 56.808 | 58.899 | 60.949 | 112.180 |
| EXP PV NO STEP | 0.800 | 0.836 | 0.869 | 0.900 | 0.928 | 0.238 | 0.244 | 0.249 | 0.254 | 0.259 | 23.179 |
| EXP PV STEP | | | | | | 0.534 | 0.548 | 0.560 | 0.572 | 0.583 | 70.516 |
| SLB CASH PRICE | | | | | | | | | | | **102.070** |

**Table 5.6** Pricing a step-up SLB with 50bps step-up, and a baseline 2% default rate versus a 3% default rate in the step-up scenario. There is a 25% probability of step-up happening

| YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SCENARIO PROB | 2.00% | 1.96% | 1.92% | 1.88% | 1.84% | 1.81% | 1.77% | 1.74% | 1.70% | 1.67% | 81.71% |
| PV CASH FLOW | 40.000 | 42.647 | 45.242 | 47.786 | 50.281 | 52.726 | 55.124 | 57.474 | 59.779 | 62.038 | 113.474 |
| PROB WEIGHTED | 0.800 | 0.836 | 0.869 | 0.900 | 0.928 | 0.953 | 0.977 | 0.998 | 1.017 | 1.034 | 92.716 |
| EVB CASH PRICE | | | | | | | | | | | **102.028** |
| PROB NO STEP | 2.00% | 1.96% | 1.92% | 1.88% | 1.84% | 1.36% | 1.33% | 1.30% | 1.28% | 1.25% | 61.28% |
| PROB STEP | | | | | | 0.68% | 0.66% | 0.64% | 0.62% | 0.60% | 19.41% |
| PV NO STEP | 40.000 | 42.647 | 45.242 | 47.786 | 50.281 | 52.726 | 55.124 | 57.474 | 59.779 | 62.038 | 113.474 |
| PV STEP | | | | | | 53.179 | 56.021 | 58.807 | 61.538 | 64.215 | 116.061 |
| EXP PV NO STEP | 0.800 | 0.836 | 0.869 | 0.900 | 0.928 | 0.715 | 0.732 | 0.748 | 0.763 | 0.776 | 69.537 |
| EXP PV STEP | | | | | | 0.361 | 0.368 | 0.375 | 0.381 | 0.385 | 22.522 |
| SLB CASH PRICE | | | | | | | | | | | **101.996** |

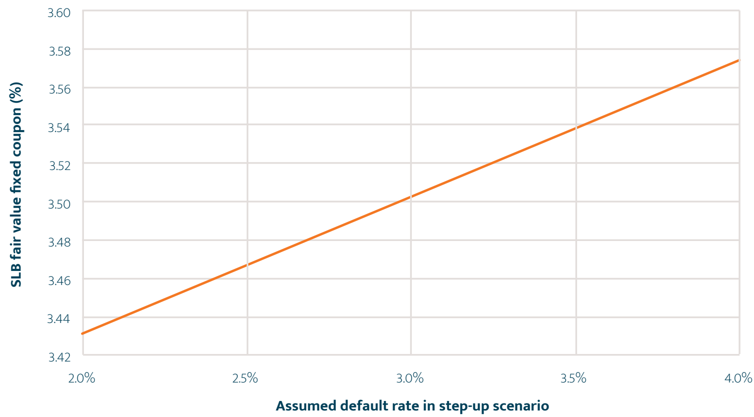
**Table 5.7** Backing out implied default rates in the step-down scenario. Setting a step-down scenario default probability of 1.52% per annum (vs 2% in a non-step down scenario) yields an SLB price equal to that of the EVB

| YEAR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| SCENARIO PROB | 2.00% | 1.96% | 1.92% | 1.88% | 1.84% | 1.81% | 1.77% | 1.74% | 1.70% | 1.67% | 81.71% |
| PV CASH FLOW | 40.000 | 42.647 | 45.242 | 47.786 | 50.281 | 52.726 | 55.124 | 57.474 | 59.779 | 62.038 | 113.474 |
| PROB WEIGHTED | 0.800 | 0.836 | 0.869 | 0.900 | 0.928 | 0.953 | 0.977 | 0.998 | 1.017 | 1.034 | 92.716 |
| EVB CASH PRICE | | | | | | | | | | | **102.028** |
| PROB NO STEP | 2.00% | 1.96% | 1.92% | 1.88% | 1.84% | 0.45% | 0.44% | 0.43% | 0.43% | 0.42% | 20.43% |
| PROB STEP | | | | | | 1.03% | 1.02% | 1.00% | 0.99% | 0.97% | 62.78% |
| PV NO STEP | 40.000 | 42.647 | 45.242 | 47.786 | 50.281 | 52.726 | 55.124 | 57.474 | 59.779 | 62.038 | 113.474 |
| PV STEP | | | | | | 52.500 | 54.675 | 56.808 | 58.899 | 60.949 | 112.180 |
| EXP PV NO STEP | 0.800 | 0.836 | 0.869 | 0.900 | 0.928 | 0.238 | 0.244 | 0.249 | 0.254 | 0.259 | 23.179 |
| EXP PV STEP | | | | | | 0.542 | 0.556 | 0.569 | 0.581 | 0.592 | 70.431 |
| SLB CASH PRICE | | | | | | | | | | | **102.028** |

It is also possible to derive investors' implied perception of higher default risks if SPTs are missed using this methodology. If we set the SLB price equal to the EVB price and solve for the step-down scenario default rate, as in Table 5.7, we get the 'market implied' default rate of 1.52% per year.

In Figure 5.3 (on the next page), we illustrate the relationship between an assumption of increased default probability in case of a step-up versus what the required "risk-neutral" SLB coupon should be, assuming the same structure as in Table 5.7. In the case of an identical default probability, we would price the SLB coupon at 3.43%. However, if the step-up conditional default probability rises to 4%, the SLB coupon required would increase to approximately 3.57%. This is higher than the EVB coupon of 3.5%.

**Figure 5.3** What is the fair value fixed coupon of a step-up SLB (as in Table 5.7) based on different assumptions on the (increased) default rate in the step-up scenario?




## 5.3 PRICING USING RATING CURVES

Predicting future default rates in absolutes is notoriously hard and impractical for forward-looking cases, for example when calculating the price of a future SLB issuance into the primary market.

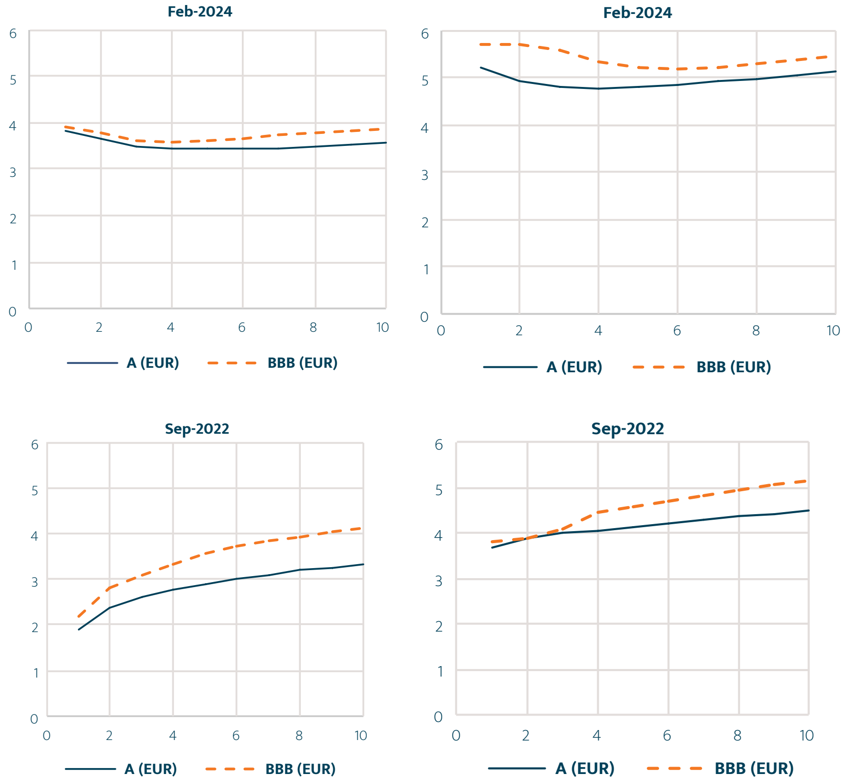
A more intuitive approach would be to express the SLB step effect as a shift in credit rating, such as "we believe this credit will upgrade one notch (e.g. from BBB to BBB+) if the issuer achieves this sustainability target". Credit ratings have the advantage of being more stable than market-implied default rates. There is also an extensive historical dataset of credit ratings that can be compared against realised default rates.

This approach depends on certain arbitrary assumptions – for example, why should the achievement of an SPT result in a one-letter[4] credit rating upgrade? In the context of credit investing, this arbitrary assumption could also be called an "investment hypothesis": e.g. "our investment hypothesis is that a coal company that has reduced coal use and switched to renewable energy in five years' time will likely have improved its credit rating by one notch". This is more palatable than the terminology of arbitrary assumptions.

The application of risky discount curves also underscores how an SLB's embedded option value is time-varying: as discount factors vary, so will the option premium of an SLB. As can be seen in Figure 5.4, the EUR curve is quite different from the USD curve, and both curves are also somewhat time-varying. For example, the USD front-end differential between BBB and A is much wider in Feb-2024 compared to Sep-2022, whereas the long-end exhibits the opposite behaviour. In all these cases, the fair value differential between a fixed SLB coupon and the EVB coupon will differ, due to different discount rates.

[4] A "one letter" upgrade (BB to BBB) is equal to a three-notch upgrade (BB flat to BB+, BB+ to BBB-, and BBB- to B flat).

**Figure 5.4** Yield (discount) curves for A and BBB credits, for EUR and USD currencies, Feb-2024 and Sep-2022




SOURCE: BLOOMBERG, AFII

## CASE STUDY 39

### OPTION VALUE USING RISKY DISCOUNT CURVES: SEMBCORP

**RESEARCH: SEMBCORP: CARBON FOOTPRINT ARBITRAGE OF A LIFETIME, NOV 2022**

**BOND: SCISP SGD2.66% 04/32 (SGXF52048042), SCISP SGD3.735% 04/29 (SGXF59468540)**

Earlier, we looked at valuing the embedded option in the Sembcorp transaction, pricing it at 0.71 cents on the dollar for an assumed 50% step probability. This calculation did not incorporate default risk, however.

To conduct a default risk analysis, we calibrate the Sembcorp EVB in terms of default probability such that the price matches the market observed price (84.00). Effectively, this means we reprice the bond while increasing default probabilities until the EVB price is equal to the market observed price. The resulting implied default probability is 2.75% per annum.

We then reprice the SLB structure, adding the likelihood that the bond defaults at this implied default rate and assuming a 40% recovery rate. The result (Case figure 39.1) is that the price differential between the SLB and the EVB reduces from 0.71 cents on the dollar to 0.58 cents. The means that after accounting for potential defaults, there is a lower probability that the investor will be able to monetise the full step-differential.

If we instead reprice the deal under the assumption that the SLB deal is pricing flat to the EVB curve, the implied default probability in the step-up state is 3.25% per annum. In practice, for an investor to view the deal as preferable to an EVB when both bonds are trading at the same price, it would need to believe a somewhat higher probability of default in the step-up scenario.

| | SLB | | | | EVB | | |
|---|---|---|---|---|---|---|---|
| | STEP OUTCOME | SCENARIO PROBABILITY | PV CASH FLOW | PROB WEIGHTED PV OF CASH FLOW | SCENARIO PROBABILITY | PV CASH FLOW | PROB WEIGHTED PV PV OF CASH FLOW |
| Scenario | | 100% | | 84.577 | 100% | | 84.003 |
| 2032 | Non-step | 37.83% | 96.399 | 36.470 | 75.67% | 96.399 | 72.941 |
| | Step | 37.83% | 97.818 | 37.007 | | | |
| 2030 | Non-step | 1.07% | 51.078 | 0.546 | 2.14% | 51.078 | 1.093 |
| | Step | 1.07% | 52.090 | 0.557 | | | |
| 2031 | Non-step | 1.10% | 50.010 | 0.550 | 2.20% | 50.010 | 1.100 |
| | Step | 1.10% | 50.833 | 0.559 | | | |
| 2029 | Non-step | 1.13% | 48.907 | 0.553 | 2.26% | 48.907 | 1.106 |
| | Step | 1.13% | 49.533 | 0.560 | | | |
| 2028 | Non-step | 1.16% | 47.763 | 0.556 | 2.33% | 47.763 | 1.111 |
| | Step | 1.16% | 48.187 | 0.560 | | | |
| 2027 | Non-step | 1.20% | 46.560 | 0.557 | 2.39% | 46.560 | 1.114 |
| | Step | 1.20% | 46.775 | 0.559 | | | |
| 2026 | Pre-step | 1.23% | 45.297 | 0.557 | 2.46% | 45.297 | 1.114 |
| | Step | 1.23% | 45.518 | 0.560 | | | |
| 2025 | Pre-step | 2.53% | 43.980 | 1.112 | 2.53% | 43.980 | 1.112 |
| 2024 | Pre-step | 2.60% | 42.613 | 1.108 | 2.60% | 42.613 | 1.108 |
| 2023 | Pre-step | 2.67% | 41.245 | 1.103 | 2.67% | 41.245 | 1.103 |
| 2022 | Pre-step | 2.75% | 40.000 | 1.100 | 2.75% | 40.000 | 1.100 |

**Case table 39.1** Pricing SLB optionality in the Sembcorp deal using market calibrated implied default probabilities

## 5.4 STOCHASTIC PRICING: THE BLACK-SCHOLES APPROACH

Our pricing frameworks have so far relied on discrete time scales and have not explicitly included the dynamics of the KPIs used to measure performance toward SPTs over time. This section will build on earlier chapters and explicitly include continuous time stochastics in a Black-Scholes type of model.[5] Although the mathematics behind the model may seem complex, it is highly practical. Moreover, what the model surfaces, as we shall see, is the importance of the 'law of motion' – meaning the probability distribution – to SPT progress.

### 5.4.1 NOTATION

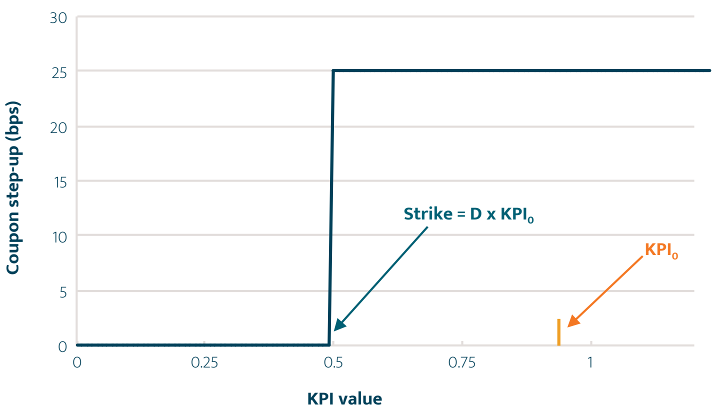
Consider an SLB that promises to pay coupons $C_t$ at future times $t = [0,...,\tau,...T]$ and principal $N$ at maturity $T$. If a predefined SPT is not met at a specified date $t = \tau < T$, the SLB will pay additional coupons $CSU_t$ (step-ups) between time $\tau$ and $T$.

The SPT is set up as a condition on one or several KPIs set against a defined baseline, $D$. For the purposes of the below model, we will consider that the SPT is linked to only one metric called $KPI_t$ and that the SPT is met if $KPI_\tau < D \cdot KPI_0$ with $D < 1$. For example, if $KPI_t$ refers to carbon emissions and the conditionality centres on a 25% emissions reduction by the measurement date $\tau$, we would set $D = 0.75$.

Note that we define the SPT in the negative, i.e. the option is only called if and when the SPT is not met, in line with market practice. Also in line with market practice, the option is of the European knock-in style, meaning that if it gets triggered at time $t$ it does not reset, even if the company performs in line or better with the SPT after $\tau$. As the SPT is based on an improvement of the KPI between $t = 0$ and $\tau$, the option is in-the-money (ITM) at the time the SLB is issued.

An investor buying an SLB is thus long an ITM European binary call option with strike $KPI_\tau$ paying a stream of coupons between $\tau$ and $T$, as illustrated in Figure 5.6.

**Figure 5.6** Pay-out of an SLB which pays a 25bps coupon step-up if the KPI does not improve by more than 50% at the defined observation date. (European binary call option – Strike = 50%)




[5] This section is based on the research paper "An option pricing approach for Sustainability-Linked Bonds", AFII, 17 Mar 2022.

To price the full structure, we assume that in buying the SLB, an investor is effectively purchasing a "traditional" fixed-rate bond ($SLB_1^0$) and a binary option ($SLB_2^0$) called if the SPT is not met. Thus, we have:

$$SLB_0 = SLB_0^1 + SLB_0^2 \tag{1}$$

where

$$SLB_0^1 = PV\left(\sum_{t=1}^{T} C + N\right) \tag{2}$$

$$SLB_0^2 = \mathbb{E}\left[\sum_{t=\tau}^{T} 1_{\{KPI_\tau \geq D \cdot KPI_0\}} \times CSU_t\right] \tag{3}$$

We assume that, under the no-arbitrage hypothesis, the value of a $SLB_1^0$ is equal to the discounted value of the future cash flows it is expected to generate:

$$SLB_0^1 = \left(\sum_{t=0}^{T} \frac{C_t}{B(O,t)} + \frac{N}{B(O,T)}\right) \tag{4}$$

We do not specify the dynamics of interest rates and assume they are deterministic. Therefore, we can express the discount factor as $B(O,i) = e^{-r_t t}$, with $r_t$ being the risk-free interest rate at time $t$. Note that we assume here that we operate in a market without default risk, unlike in the previous sections.

Assuming $CSU_t$ and $KPI_t$ are independent, we can write $SLB_2^0$ in the following form:

$$SLB_0^2 = \mathbb{E}\left[1_{\{KPI_t \geq D \cdot KPI_0\}}\right] \cdot \mathbb{E}\left[\sum_{t=\tau}^{T} CSU_t\right] \tag{5}$$

The equation specifies that the value of the binary option is equal to the expectation that the SPT will be met multiplied by the discounted value of the coupon step-up cash flow if the option triggers. Equation (5) can be reduced to a simpler expression:

$$SLB_0^2 = \mathbb{E}\left[1_{\{KPI_\tau \geq D \cdot KPI_0\}}\right] \cdot \sum_{t=\tau}^{T} \frac{CSU_t}{B(O,t)} \tag{6}$$

Breaking down the SLB pricing so far, we can see that at its core is a measure of the probability that the SPT will trigger, $\mathbb{E}\left[1_{\{KPI_\tau \geq D \cdot KPI_0\}}\right]$ ·

Equation (1) confirms what we have seen in earlier pricing sections: in the SLB structure, the differential in spreads should be decomposed into the traditional greenium and the option value inherent in the coupon structure.

### 5.4.2 COUPON STEP-UP PROBABILITIES

We note that in order to price the step-up optionality – and thus the SLB in its entirety – one needs some sort of hypothesis to explain the dynamics of the KPIs. This is necessary to define a range of outcomes and their likelihood. It is not a trivial task, and for this purpose it is useful to establish that some SLBs will be priceable (meaning it is possible to derive some meaningful hypothesis on probabilities) and some will be non-priceable (lacking means of deriving probabilities). Such a classification allows investors to distinguish between weak or robust KPIs and should be a key input into the investment (sizing) decision. Chapter 4 discusses target setting in more detail.

To illustrate the centrality of probability measures, let us turn to the example of an SLB structured around a carbon emissions KPI and SPT. A standard construct is to relate the issuer's emissions to some threshold reduction level at time $t$. If the emissions reduction is insufficient, the coupon steps up.

To derive the likelihood that the SPT will trigger, and thus be able to price the structure appropriately, we suggest the following framework on KPI evolution:

1) The issuer's own current emissions ('relative position', marked as the blue dot in Figures 5.7-5.9).

2) The issuer's sector emissions and emissions trend ('exogenous trend', $CE^{SECT}$). These are provided exogenously, for example by standards such as the Science Based Targets Initiative (SBTi).

3) The issuer's own emissions trend ('deterministic trend', $CE^*$, see 5.9). A special case is where we make no assumptions, i.e. we hold the trend growth at zero, $z$, as in Figures 5.7 and 5.8.

4) The distributional properties of the KPI as depicted by the titled probability density functions (blue, yellow) in the figures. We will assume that these are normal distributions with varying volatility.

Let us first look at a scenario as illustrated in Figure 5.7 where we assume there is no endogenous carbon reduction trend for the company. If left un-incentivised, the company's carbon emissions would follow a completely stochastic process with no expectation of emissions reductions. If at the same time we assume that the carbon emissions process linked to the coupon step-up is also a zero-expectation random process, it is obvious that the value of the binary option is simply a proportion of the discounted future cash flow value. It is 50/50 that the stepped-up coupons are received. However, as illustrated in Figure 5.7, there will be some probability distribution (blue) around that zero increase level $CE^0$.

**Figure 5.7** Evolution of SLB KPI over time: no carbon emission increase, no endogenous trend

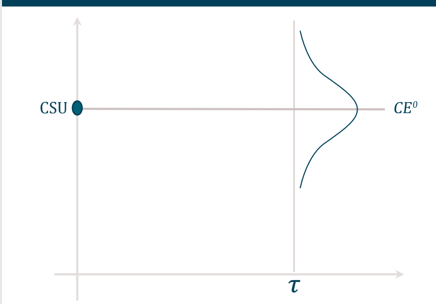
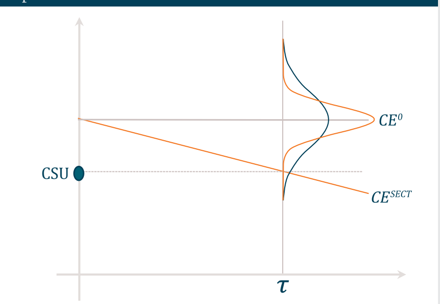



**Figure 5.8** Zero ambition, sector carbon decrease trend: how higher volatility (blue pdf) makes the option value lower

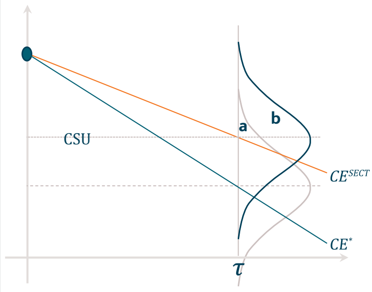


Turn instead to a second scenario, Figure 5.8, where the investor posits that carbon emissions need to shrink by 5% ($CE^{SECT}$) per annum to align with exogenous expectations, and assumes there is no internal reduction trend within the company. The issuer's emissions remain completely stochastic, following the yellow, low volatility, probability distribution. In this case, there is zero probability that the company will hit the SPT, and thus the value of the step-up option should be equal to the discounted value of the stepped-up coupon cash flows.

However in this case, it makes intuitive sense that increased volatility (the blue probability distribution in the figure) translates to a lower probability that the step-up will materialise.[6] Thus, the premium for the step-up option shall be lower when volatility is higher.

Finally, we look at a third scenario, Figure 5.9, where the SPT ambition is linked to a sector decrease in carbon emissions (say 5% per annum). However, the company is deemed to have an even more ambitious reduction trajectory, $CE^*$. If the investor agrees to align the sustainability condition to the sector trend, the company can "arbitrage" the premium they have been paid (corresponding to a+b). If they achieve the trajectory $CE^*$, the premium b that they have received is an overcompensation paid by the investors.

**Figure 5.9** High ambition, sector carbon decrease trend: how higher volatility and ambitious trend makes the option value lower




This leads to an interesting conclusion. If investors are driven by scientific targets, and therefore know roughly what a company should achieve in order to be sustainability-aligned, but the issuer exhibits higher ambition (recognising that there will be cost associated with that ambition), then there is an excess optionality premium that accrues to the benefit of the issuer.

[6] The probability that the coupon will not step up is the part of the probability distribution south of the $CE^{SECT}$ line. It follows that the probability that coupon will step up is everything north of the line. In Figure 5.8, the blue distribution (with higher volatility) has a bigger mass south of the line than the yellow distribution (lower volatility). Hence, the higher volatility distribution provides a lower probability for a step up and consequently less value in terms of optionality.

To formalise Figure 5.9, the KPI is defined as the company's carbon emissions $CE_t$ at time t, and $CE_0$ are the emissions at time zero, i.e. at issuance of the bond.[7] Thus,

$$SLB_0^2 = \mathbb{E}\left[1_{\{CE_\tau \geq D \cdot CE_0\}}\right] \cdot \sum_{t=\tau}^{T} \frac{CSU_t}{B(0,t)}$$

Let us now more specifically define the dynamics of the hypothetical process driving whether the sustainability condition will be met or not, i.e. how do we specify $CE_i$ to evaluate $\mathbb{E}\left[1_{\{CE_\tau \geq CE_0\}}\right]$? We allow carbon emissions progress to be described by a geometric Brownian motion, satisfying the following differential equation:

$$\frac{dCE_t}{CE_t} = \delta dt + \sigma dW_t$$

where δ (the "drift") is the general trend that the company needs to match in terms of its sustainability target. This parameter essentially defines what the company needs to outperform to avoid having to pay stepped-up coupons.

The parameter δ provides the volatility metric of this stochastic process. In our framework, we see this reflecting two dimensions. Firstly, the magnitude of the stochastics affecting the company in terms of normal random events (e.g. changes in demand, production techniques based on raw materials etc) and, secondly, the capacity for the company to influence the evolution of the sustainability factor themselves. We can also interpret this number as a measure of the investor's confidence that the company has the means to actually meet its SPT. This is an important point worth repeating: a high confidence that the company could reach the target (meaning a high volatility factor) implies, ceteris paribus, a lower probability that the investor will receive stepped-up coupons.

For example, consider a thermal coal company issuing an SLB with a condition to cut thermal coal production by 50% in five years. The investor considers it very unlikely that the issuer will meet this condition, as it requires a complete overhaul of the current business model. It thus assigns the bond a high step probability. The optionality in this case is therefore more valuable to the investor than had the issuer set a more achievable SPT. Taking this to the next step, the thermal coal issuer could extract a higher premium/lower cost-of-capital for setting an ambitious target than if they were less ambitious. Note the potential for different views on the volatility/probability factor if you are an investor or issuer.

[7] We will return to more specific metrics around carbon emissions below.

Using the closed form of the Black-Scholes formula for binary options pricing[8] and the law of motion in (7), the price of the resulting coupon stream $SLB_0^2$ can then be expressed as:

$$SLB_0^2 = \phi(d_2) \cdot \sum_{t=\tau}^{T} \frac{CSU_t}{B(0,t)}$$

with:

- $\phi$ the cumulative distribution function
- $d_2 = d_1 - \sigma\sqrt{t_\tau}$, $d_1 = \frac{ln\left(\frac{CE_0}{D}\right)+\left(\delta+\frac{\sigma^2}{2}\right)\cdot t_\tau}{\sigma\sqrt{t_\tau}}$,
- D being the option's strike price

In the language of options pricing, the investor is buying a (binary) European call option where the process governing the payout is not based on the underlying asset price itself, but another stochastic process.

As discussed in the basic pricing chapter, the SLB issuer is selling the call option and collecting the premium. Combining current emissions, drift parameters, volatility, and call dates defines how far in- or out-of-the-money the option is on issuance date, which has a commensurate effect on the price of the option/SLB.

Under the hypothesis that there is no arbitrage in the bond markets and that investors are not assigning non-pecuniary effects (greeniums) to their investments, the price of an SLB should be equal to the price of an EVB issued on the same day and with the same maturity, paying fixed coupons $C_t'$ between $t_1$ and $t_T$. Thus, we can write:

$$SLB_0 = \underbrace{\left(\sum_{t=1}^{T} \frac{C_t}{B(0,t)} + \frac{N}{B(0,T)}\right)}_{\text{TRADITIONAL BOND COMPONENT}} + \underbrace{\phi(d_2) \times \sum_{t=\tau}^{T} \frac{CSU_t}{B(0,t)}}_{\text{COUPON STEP-UP PREMIUM}} = \left(\sum_{t=1}^{n} \frac{C_t'}{B(0,t)} + \frac{N}{B(0,T)}\right)$$

This equation tells us that in the absence of non-financial considerations from investors the spread between $C_t$ and $C_t'$ should be a function of the SLB's embedded option price adjusted for discount factors:

$$\sum_{t=0}^{n} \frac{C_t' - C_t}{B(0,t)} = \phi(d_2) \cdot \sum_{t=\tau}^{n} \frac{CSU_t}{B(0,t)}$$

It should be noted that all else equal, the relationship between the coupon step-up and the option price is linear according to the above equation.

[8] Options, Futures, and Other Derivatives – John C. Hull.

### 5.4.3 PARAMETER CALIBRATION

As discussed in the previous section, the price of the option embedded in the SLB depends on the calibration of two parameters: the drift and the volatility of the KPI. The direct way to calibrate the option parameters would be to look at the historical data of the KPIs and from that data infer the dynamics of the KPI.

Put more simply, to forecast how likely it is that the KPI will achieve the SLB condition (the SPT), we need to have some idea about the dynamics of the KPI such that we can generate a forecasting model for it. This is expressed in Figures 5.7-5.9.

Forecasting requires the KPI to be (1) measurable, and (2) have actual time-series data available. These requirements are set out in ICMA's "Voluntary Process Guidelines for Issuing Sustainability-Linked Bonds" (June, 2020): "The KPIs should be: [...] measurable or quantifiable on a consistent methodological basis." [9]

For the purposes of our methodology, an SLB with KPIs that fulfil conditions (1) and (2) is defined as a step-up priceable (SUP) SLB, which simply means we can infer some sort of probability distribution for the likelihood of a coupon step-up. SLBs where little to no inference can be made we define as step-up non-priceable (SUN).

This categorisation does not relate to the quality of a bond's non-financial impact. A SUN-SLB may have much greater non-financial impact (and hence have more implicit value for investors looking for this quality) than a SUP-SLB, and thus attract a higher premium. However, the categorisation does require that a SUN-SLB be priced differently than a SUP-SLB. The advantage of the SUP-SLB is that under our methodology it can be partially priced, which should lead to a lower uncertainty premium, ceteris paribus, for the SUP-SLB vis-à-vis the SUN-SLB.

Assuming we are working with a SUP-SLB, and assuming a law of motion as of Equation (7), it is clear that calibrating drift and volatility parameters are a key part of pricing.

**Drift – $\delta$**

The drift parameter can be understood as an acceptable trend factor: the minimal rate of KPI improvement required by some robust benchmark. For example, in the context of carbon emissions, 'drift' could be a macro target like the reduction in absolute emissions needed per annum to align with the Paris Agreement. According to the Intergovernmental Panel on Climate Change (IPCC),[10] limiting global warming to below 2°C requires a decline in emissions of 25% from 2010 levels by 2030 (-2.84% p.a.) whereas the 1.5°C scenario entails a decline of 45% (-5.80% p.a.).

Clearly the required reduction in emissions needed to achieve these targets differs between sectors and industries, but until these are more widely available the macro target should suit an investor trying to align a diversified portfolio with Paris targets.

Other, more specific, ways to calibrate the drift rely on issuance-level analysis based, for example, on the below parameters:

- Historical data
- Science-based targets
- Peers-based comparison
- Issuer's own declared sustainability targets
- Climate scenarios
- Regulatory requirements

This highlights the need for further research into relevant drift terms, but the advantage of specifying a single drift term is that it becomes in some form comparable across SLBs, such that investors can have a first go at contrasting the ambition levels of issuers.

[9] We also note the added condition with respect to benchmarks: "[...] able to be benchmarked, i.e. as much as possible using an external reference or definitions to facilitate the assessment of the SPT's level of ambition", which is relevant in the context of our earlier discussion around ambition levels.

[10] "Special report on the impacts of global warming of 1.5 °C above pre-industrial levels and related global greenhouse gas emission pathways", IPCC, 2018.

**Volatility** – σ

To account for the issuer's capacity to influence its carbon emissions, we can express volatility as follows:

$$\sigma = \sigma_i \cdot \beta$$

where:

- $\sigma_i$ is the carbon emissions' intrinsic volatility, calculated based on the issuer's historical data (i.e. historical volatility).

- $\beta$ is a measure of magnitude of the issuer's capacity to influence its carbon emissions.

We recognise the complexity involved in calibrating the $\beta$ parameter, as it depends on investors' appreciation of the issuer's sustainability profile. Where no strong views exist, one can/should simply set $\beta = 1$.

If one decides to apply $\beta$ adjustments, an issuer perceived as unlikely to improve its carbon emissions profile (for example, an issuer without a credible transition plan or management team) would be assigned $\beta<1$, whereas an issuer whose management is fully committed to transitioning to a low-carbon production process would get a $\beta>1$. Remembering our earlier discussion about a divergence between investors' and issuer's beliefs on targets being reached, this difference would manifest through varying values of $\beta$.
If we assume that investors have a belief $\beta$, and the issuer has its own $\beta^*$ such that $\beta < \beta^*$, then by necessity investors' volatility assumption will be lower than the issuer's: $\sigma < \sigma^*$. This implies that the issuer can harvest an excess SLB premium.

In Case 40 we exemplify how to parameterise the option pricing model in this way. A number of other case studies in this book utilise the same approach.

# CASE STUDY 40

## SLB PRICING WITH BLACK-SCHOLES: SUZANO

**ISSUER:** SUZANO (TICKER: SUZANO) **ISSUE SIZE:** USD1.25BN

**BOND:** SUZANO USD3.34% 01/31 (US86964WAJ18)

**ISSUE DATE:** SEPTEMBER 2020 **MATURITY DATE:** 15 JANUARY 2031

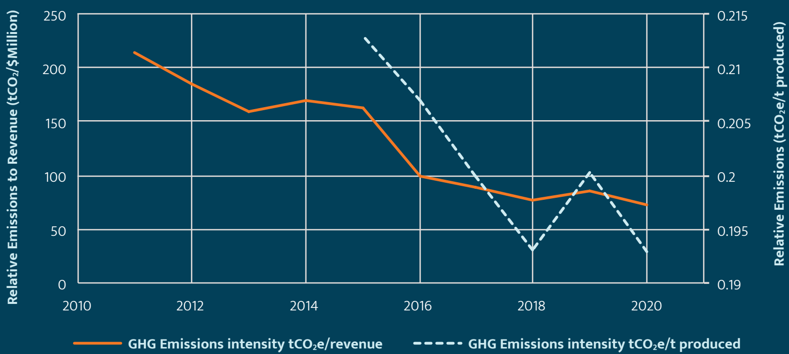
**COUPON:** 3.75% WITH A 0.25% STEP-UP IF THE COMPANY DOES NOT MEET ITS "SUSTAINABILITY CONDITION"

**SUSTAINABILITY CONDITION:** a reduction of Greenhouse Gas Emissions Intensity to 0.190 $tCO_2e$/ton produced or less by the end of 2025, equivalent to at least an estimated 10.9% reduction as measured against the 2015 baseline year, calculated by taking the average of the $tCO_2e$/ton produced for the years 2024 and 2025.

Brazilian paper company Suzano entered the SLB market as early as 2020, raising approximately USD2.75 billion through four transactions. Suzano estimates the greenium of its 09/14 SLB issuance at 15bps compared to a non-SLB bond.

The Suzano 3.75% SLB's sustainability condition is linked to emissions intensity relative to output produced, which is a common KPI in the space. Notably, the KPI upon which the sustainability condition is based is averaged over two years rather than being a point-in-time measure. From a technical standpoint, this lowers the volatility of the KPI. However, we deem the effect of this calculation choice to be small, and consider the sustainability condition only observed for the year 2025. Our readers will notice that averaging data collected on predetermined observation dates results in a lower volatility, hence a reduced option price (an "Asian" option in the world of derivatives trading).

Obtaining KPI volatility in this case is not straightforward as we only have six historical data points for the intensity of carbon emissions relative to the tons of pulp and paper produced, as illustrated in Case figure 40.1. Arguably, this is too small sample size to have a strong inference on the volatility parameter even if it is still more than for most SLBs.




**Case figure 40.1** Suzano's carbon emissions relative to revenue vs tons produced. Source: Bloomberg, Suzano, AFII

As an alternative, we proceed by using intensity per sales (rather than production) as a proxy. This dataset provides us with eleven data points and seems fairly correlated with the intensity per tons produced. It should be noted that the quality of our approximation depends on the stability of Suzano's products prices. Using the $CO_2e$/t proxy, we estimate the historical volatility such that $\sigma_i$ = 16.56%.

According to the second party opinion, Suzano's transition plan is in line with peers. Moreover, its Bloomberg ESG Disclosure data score is above the sector's median, such that we see little need to do any $\beta$-adjustment. Thus, we set $\sigma = 16.56\% \cdot 1 = 16.56\%$.

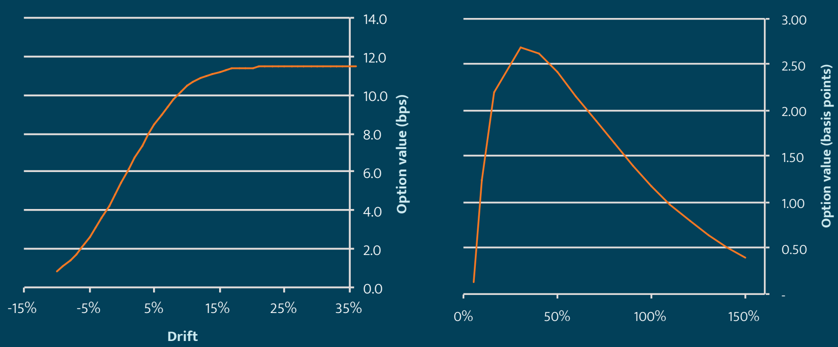
Using this, we calculate the option value in the SLB based on various drift parameters:

- IPCC 1.5 degrees (-5.80% p.a.) ⇔ 2.20bps option value
- IPCC 2 degrees (-2.84% p.a.) ⇔ 3.71bps option value
- Historical drift (-1.96% p.a.) ⇔ 4.23bps option value

This illustrates the optionality effect quite clearly. Depending on the assumed ambition level, the option premium value (which accrues to the issuer) changes between 2.2-4.2bps. If Suzano were to continue decarbonising as it has done historically, the likelihood is high that it would not meet its SLB condition. This in turn leads to a high valuation of the coupon step-up option, illustrated in Case figure 40.2. Once the drift becomes high, the option value converges to the value of the discounted step-up payments, in this case almost 12bps.

In Case figure 40.2 (right) we see that the option price is a bell-shaped function of the volatility, which is somewhat intuitive: the bigger the potential movements in carbon intensity the higher the probability to meet the SPT. However, as the drift is far in the negative territory, too small movements (i.e. volatility) around the trend decrease the probability of meeting the SPT.

With these inputs and after applying Equation (9)-(10), we find that the premium as measured using the inherent value of the coupon step-up for Suzano's SLB should have been 2.2bps. At the time of issuance, it was stated that the total greenium in the issuance was 15bps. Hence, if we took that stated number of total greenium at face value, then we would deconstruct this as 12.8bps of non-pecuniary, "traditional" greenium and 2.2bps of optionality value.




**Case figure 40.2** (left) Sensitivity of Suzano SLB optionality to the drift parameter; (right) Sensitivity of the option value to volatility

# CASE STUDY 41
## SLB PRICING WITH BLACK-SCHOLES: REPSOL

**ISSUER:** REPSOL (TICKER: REPSM) **ISSUE SIZE:** EUR650MN

**BOND:** REPSM EUR0.375% 07/29 (XS2361358299), REPSM EUR0.875% 07/33 (XS2361358539)

**ISSUE DATE:** JUNE 2021 **MATURITY DATE:** JULY 2029

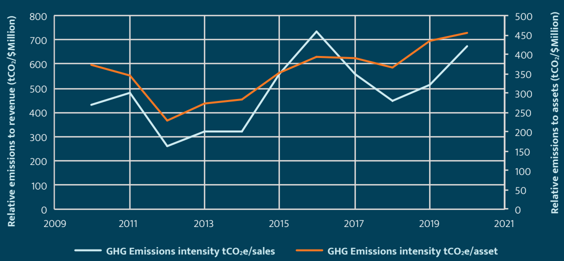
**COUPON:** 0.375% WITH A 0.25% STEP-UP IF THE COMPANY DOES NOT MEET ITS "SUSTAINABILITY CONDITION"

**SUSTAINABILITY CONDITION:** REDUCTION IN REPSOL'S CARBON INTENSITY INDICATOR OF 12% BY 2025

Oil multinational Repsol launched its first SLB in June 2021, raising EUR1.25bn over an 8yr and a 12yr tranche. Our study focuses on the 8y tranche, which offers investors a 25bps step-up in 2027-29 if the company does not achieve a 12% carbon intensity reduction by 2025. By contrast, the 12yr bond, REPSM 0.875 07/2033 (XS2361358299), offers a step-up of 37.5bps per annum in 2032-33 if the carbon intensity KPI has not declined 25% by 2030.

For this SLB, Repsol designed its own methodology for calculating its carbon intensity (CII – Carbon Intensity Indicator) which "measures the $CO_2e$ emissions for every unit of energy that the company makes available to society." From a pure pricing standpoint, the internal definition poses several issues: (1) the company did not – to our knowledge – make historical data publicly available on the evolution of this KPI, thus making probabilistic inference only possible via proxy; (2) translating science-based goals in terms of SPT expectations (and subsequently defining the drift) might prove highly complex.

However, we still find it useful to evaluate this SLB from a proxy KPI perspective. Coming back to our statistical estimates, after reviewing the KPI definition, we believe "Carbon Emissions relative to Revenue" to be an acceptable proxy. Repsol's CII measures the company's $CO_2$ equivalent emissions (numerator) relative to energy obtained through their products (denominator) which is directly linked to the number of products sold by the company. The drawback is that carbon emissions relative to revenue are calculated in nominal terms. We evaluate the historical volatility at 32.2%.




**Case figure 41.1** Repsol's carbon intensity relative to revenue and assets. Sources: Bloomberg, AFII

Using the IPCC target 1.5 degree drift (-5.80%) and a beta parameter of 1, we arrive at a valuation for the optionality of 3.3bps. Note that the issuer compared the future values to a 2016 baseline. This may be useful optically – a 12% reduction from 2016 may sound bigger than e.g. a 5% reduction from 2018 – however in terms of the pricing model, only the latest data is relevant when it comes to deciding how likely it is that the step-up condition will (not) be met.

Our first sensitivity analysis with regards to this structure looks at how the option value could change in relation to more ambitious coupon step-ups. We illustrate this in the left-hand panel of

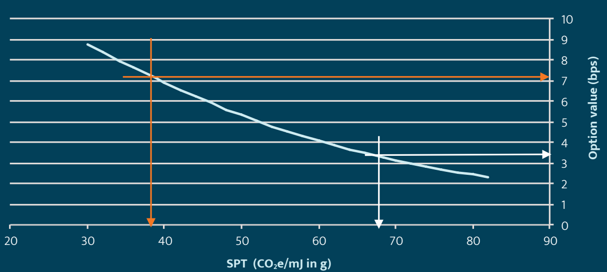
Case figure 41.2. Holding the other parameters of the model constant, we can see that in order to get to a 10bps option value premium, the coupon step-up should have been 76bps instead of 25bps (shown as the blue arrow relationship in the graph). This illustrates how the issuer can target a certain all-in-greenium for the SLB by adjusting the size of the coupon. Although it might seem trivial, it may be of some importance when deciding on the structure of an SLB to understand that higher coupon step-ups generate lower cost-of-capital for the issuer in an almost mechanical, linear way.

In the right-hand panel of Case figure 41.2, we look at the impact of the first coupon step-up date on the option value. Intuitively, the option value increases as the time-period in which the step-up is paid lengthens. Ceteris paribus, a structure that (potentially) starts paying coupon step-ups close to the issue date is more valuable than one that starts paying near the maturity date. Nonetheless, our readers will observe that the relationship is not linear. As time passes, the probability of reaching the target increases. This leads to a lower probability that the SLB will pay the coupon step-up.


**Case figure 41.2** (left) Coupon step-up as a function of the option value; (right) Option value as a function of the timing of the coupon step-up. Source: AFII, Bloomberg

Another application of the model is to calculate the option value as a function of the SPT. As shown in Case figure 41.3, the theoretical option value of Repsol's SLB would have more than doubled had the SPT been set at 38.85g $CO_2e$/MJ (orange lines) instead of 68.4g $CO_2e$/MJ (white lines), i.e. a 50% CII reduction compared to the 2016 baseline.

From an optionality standpoint, a more ambitious SPT entails an option that is even more "in-the-money" and subsequently higher priced. Indeed, in its 2021 Sustainability Report, Repsol announced an absolute Scope 1 + Scope 2 emission reduction target of 55% to 2030, which – if adhered to and incorporated in an SLB framework – would have allowed the issuer to reap that 10bps option premium. It could also have banked a reduction of uncertainty premium, since from a statistical perspective such a target would have been much easier to generate data for and to monitor.




**Case figure 41.3** Option value in the Repsol case as a function of the SPT. Source: AFII, Bloomberg

## 5.5 MULTIPLE KPIS

So far, we have focused on SLBs with carbon emissions as the only KPI. However, many SLBs depend on more than one KPI. As an example, in 2021 Enbridge issued an SLB linked to carbon emissions, workforce diversity, and percentage of women on the board.[11] Although integrating multiple KPIs can be perceived by the market as evidence of the issuer's commitment to its sustainability strategy, we want to bring our readers' attention to the resulting increased pricing complexity. Here, the distinction between SUP- and SUN-SLBs is very important.

If we consider an SLB dependent on two KPIs, Equation (3) becomes:

$$SLB_0^2 = \mathbb{E}\left[\sum_{t=\tau}^{T} 1_{\{KPI_\tau^1 \geq \mathrm{D}\cdot KPI_0^1\}} \cdot 1_{\{KPI_\tau^2 \geq \mathrm{G}\cdot KPI_0^2\}} \times CSU_t\right]$$

To estimate the value of $SLB_2^0$, we now need to consider that either $KPI^1$ and $KPI^2$ are independent, or be able to model their correlation. Regarding independence, studies show that even if the KPIs belong to different ESG segments, the correlation is likely to be high. A 2020 study evaluates the average correlation between the E and S factors at 0.79 for S&P500 companies.[12] In the second case where correlation exists, we need to explicitly model it. In a bivariate case, this is straightforward if one has sufficient data. It is slightly more complicated when considering three or more KPIs that are not easily measured or supported by quality data. It is hard enough to define the dynamics of one time-series in the ESG context, let alone the interdependence between several, thus making it hard to define such instruments as SUP-SLBs.

Having said that, investors and issuers could consider having one core KPI in their structure that is step-up priceable, and then add others in for good measure, but with the expectation that they will not be likely to derive a premium for them.

[11] "Enbridge oil sands SLB – participation trophy alert", AFII, 23 Jun 2021.

[12] "Does environmental, social and governance performance influence economic performance?," K. Cek and S. Z. Eyupoglu, Journal of Business Economics and Management 21(4):1165-1184, 2020.

# 06
# ADVANCED MODELLING

# 06 ADVANCED MODELLING

## SECTIONS



## CASE STUDIES

"Although we have made a point of keeping the SLB features parsimonious, it is also important to see how it can act in more advanced credit usages."

## 6.1 SLBS FOR SPECIFIC CREDIT SOLUTIONS

Earlier chapters have argued for the similarity of the SLB with vanilla bonds, while also diving into some of the more complex features. This chapter will explore some particularly complex features, such as SLBs further down in the capital structure, SLBs with credit enhancement and the callability features of SLBs.

Although we have made a point of keeping the sustainability features of the SLB as parsimonious as possible, it is also important to see how the SLB acts in more advanced credit usages, in order to maximise the 'interoperability' mentioned in Chapter 3.

First, we cover the nascent SLB hybrid debt market, noting that the characteristic features of hybrids (bonds with coupon steps, dependency on ratings/credit risk), are similar to those exhibited by SLBs.

Second, we discuss a particular use cases where the flexibility of the SLB is used to create a blended finance-type bond involving public and private sector stakeholders. This Contingent Resilience-Linked (CORL) bond would require a step-down structure to function. It would also rely on investors believing in a correlation between the achievement of certain resilience targets and lower credit risk.

Lastly, an oft-mentioned critique of SLBs (flagged in Chapter 1) is addressed through a close study of the callability inherent to SLBs. This callability is a concern of external stakeholders, especially when calls are set prior to step-up/down dates. Some have even labelled them 'structural loopholes.'

However, our analysis suggests that callability is not the flaw it is made out to be. The bond market in general has moved towards more callability and SLBs are following that trend. Newer vintages of bonds are simply more frequently callable.

## 6.2 HYBRID SLBS

Sustainability-linked hybrid bonds, debt instruments either with a very long maturity or no maturity (also known as perpetual bonds/perps), combine elements of conventional debt and equity. They look like debt in that they typically have fixed coupons and a set repayment of nominal capital. They look like equity due to their long or no maturity and subordinated position in the capital structure.

The benefit of issuing hybrids derives from their accounting treatment. For example, if certain conditions are met, a hybrid instrument can be accounted for as an equity liability under International Financial Reporting Standards (IFRS), which may improve balance-sheet ratios such as debt-to-equity. Rating agencies also often consider the liabilities to be 50% equity and 50% debt, making hybrids an efficient way to raise debt capital without risking a rating downgrade.[1] However, things get more complicated when considering hybrids in an SLB context, also sometimes called SLPs (sustainability-linked perpetuals). For example, S&P has been very clear that any step-up coupon included in a perpetual bond would remove its equity treatment.[2] This is driven by an assumed correlation between missing sustainability targets and credit deterioration:

[1] "Issuance of hybrid debt instruments and so-called contingent convertible bonds (CoCo)", Clifford Chance, Aug 2016.

[2] "Sustainable Finance: Equity Content And Sustainability-Linked Hybrids", S&P, 10 Feb 2020.

*"We could consider failure to meet a sustainability target to be a constraint to the issuer's creditworthiness, even if the overall impact is marginal and does not lead to a downgrade or outlook revision. [...] If the cost of servicing the hybrid, or the likelihood of redeeming it, increases in response to deterioration of the issuer's creditworthiness, we would assess the hybrid as having no equity content."*[2]

A belief that sustainability performance impacts creditworthiness is, as outlined in Chapter 3, core to the assessment of SLBs as a risk hedge. For the investor, a step-up provides compensation for any related price deterioration driven by weakening credit. Step-down coupons could be a solution, but for the step-up option, S&P is resolute in its view.[3]

Fitch and Moody's are reported to be more flexible in considering equity treatment for SLPs,[3] depending on the size of the coupon step-up. The Japanese Credit Rating Agency has offered a more positive approach. Step-up coupons are seen primarily as providing incentives to improve sustainability and are separate from its requirements for an equity assessment.[4] Indeed, the agency provided an equity content assessment for large sustainability-linked loan hybrids, although we have been unable to confirm the issuance of that debt.[5]

Nevertheless, we note that all SLPs issued to date are from unrated corporates, (see Table 6.1) and view rating agency treatment as a key obstacle to market growth.[6]

**Table 6.1** Sustainability-linked hybrid issuance. Source: Bloomberg, accessed 12 Jan 2024

| ISSUER | TICKER | ISIN | PRICING | SECTOR | CURRENCY | SIZE | RATING |
|---|---|---|---|---|---|---|---|
| VOSSLOH AG | VOSGR | DE000A3H2VA6 | 15 Feb 21 | Industrial | EUR | 150,000,000 | NR |
| UBM DEVELOPMENT AG | UBSAV | XS2355161956 | 11 Jun 21 | Consumer, Cyclical | EUR | 100,000,000 | NR |
| CHINA HUANENG GROUP | HUANEN | | 23 May 22 | Utilities | CNY | 1,300,000,000 | NR |
| CHINA HUANENG GROUP | HUANEN | | 23 May 22 | Utilities | CNY | 700,000,000 | NR |
| HUANENG LANCANG HYDRO | HUANEN | | 06 Jul 22 | Utilities | CNY | 2,000,000,000 | NR |
| CHINA RAILWAY CONSTRUCT | RLCONS | CND10006PZD5 | 18 Jul 22 | Industrial | CNY | 1,500,000,000 | NR |
| CHINA RAILWAY CONSTRUCT | RLCONS | CND10006PZF0 | 18 Jul 22 | Industrial | CNY | 1,500,000,000 | NR |
| JX WATER CONSERVANCY INV | JXWCIG | | 19 Jul 22 | Industrial | CNY | 1,000,000,000 | NR |
| HUANENG POWER INTL INC | HNINTL | | 22 Jul 22 | Utilities | CNY | 2,000,000,000 | NR |
| CRBC INTERNATIONAL | CRBCIN | | 18 Aug 22 | Industrial | CNY | 1,000,000,000 | NR |
| CCCC FIRST HIGHWAY ENGIN | CCCCFH | | 28 Sep 22 | Industrial | CNY | 1,000,000,000 | NR |
| PINGDINGSHAN TIANAN COAL | PINGMI | CND10005YP70 | 12 Dec 22 | Energy | CNY | 800,000,000 | NR |
| ELTEL AB | ELTEL | SE0019914250 | 30 Mar 23 | Communications | EUR | 25,000,000 | NR |
| WUXI INDUSTRY DEVELP | WUXIND | CND10006C8X3 | 17 Apr 23 | Consumer, Cyclical | CNY | 500,000,000 | NR |
| KNOWLEDGE CITY INV GROUP | KCGZIG | CND10007B5T7 | 12 Jun 23 | Financial | CNY | 1,000,000,000 | NR |
| JIANGYIN PUBLIC ASSET | JYCPAM | CND10006T941 | 21 Jul 23 | Industrial | CNY | 700,000,000 | NR |
| DATANG SICHUAN POWER | DTSCPW | CND10006XLZ2 | 15 Aug 23 | Utilities | CNY | 500,000,000 | NR |
| DATANG SICHUAN POWER | DTSCPW | CND10006XM08 | 15 Aug 23 | Utilities | CNY | 500,000,000 | NR |
| SHANDONG HI-SPEED GROUP | SDEXPR | CND10007BGF8 | 23 Aug 23 | Industrial | CNY | 1,500,000,000 | NR |
| SINOHYDRO 11 BURE CO | SINOHY | CND10006Z9H7 | 01 Sep 23 | Industrial | CNY | 700,000,000 | NR |
| JIANGSE REGUARANTEE GRP | JSREIN | | 10 Nov 23 | Financial | CNY | 1,000,000,000 | NR |
| JIANGXI PROVINCE INV GRP | JXPIVG | | 28 Nov 23 | Industrial | CNY | 2,000,000,000 | NR |
| CHINA CONST 3RD ENGINEER | CCTEJS | | 19 Dec 23 | Industrial | CNY | 1,200,000,000 | NR |
| STT GDC PTE LTD | STTGDC | | 08 Jan 24 | Communications | SGD | 450,000,000 | NR |

[2] "Sustainable Finance: Equity Content And Sustainability-Linked Hybrids", S&P, 10 Feb 2020.

[3] As reported in "The missing market: sustainability-linked hybrids", GlobalCapital, 11 Jan 2024.

[4] "Requirements for Equity Content for Sustainability-Linked Hybrid Financing", JCR, 5 Sep 2022.

[5] "The Chugoku Electric Power Company Subordinated Loan Rating", JCR, 29 Jun 2022.

[6] There is one small, private exception, the combined SLP/convertible ALDAU Frn 06/82 call 28 (AU3FN0069704), which is rated by Moody's and further commented in Chapter 1.

# CASE STUDY 42
## SUSTAINABILITY-LINKED HYBRIDS: STT GDC

**RESEARCH:** STT GDC ISSUES A SUSTAINABILITY-LINKED PERPETUAL, JAN 2024

**BOND:** STTGDC SGD5.7% 07/72 (SGXF26579122)

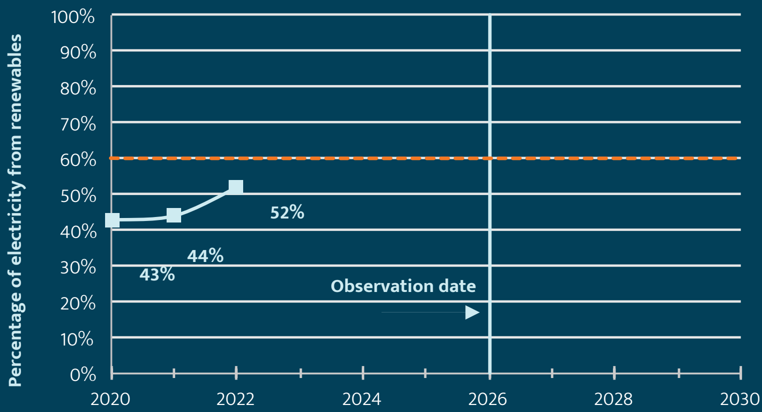
STT GDC is a Singaporean data centre provider, with over 170 data centres across Asia and the UK. It is wholly owned by ST Telemedia, a direct and wholly-owned subsidiary of Temasek Holdings, Singapore's sovereign wealth fund. The company has three bonds outstanding (as shown in Case figure 42.1). Prior to this hybrid issuance, it had two bullet bonds, one of which matures this year. As a privately-owned issuer, the debt markets are the only point of engagement for investors. The company released its Sustainability-Linked Financing Framework (SLFF) in Jul 2022 with three KPIs. KPI 1 is the percentage of electricity consumed from renewables, KPI 2 the carbon intensity of STT GDC operations, and KPI 3 the proportion of data centres that are classified as 'green buildings.' The Second Party Opinion (SPO), provided by Sustainalytics, rated only the first as 'strong', and only this KPI was chosen for the ultimate issuance in Jan 24.

| DESCRIPTION | ISIN | ISSUE DATE | MATURITY | CURRENCY | AMOUNT OUTSTANDING |
|---|---|---|---|---|---|
| STTGDC SUSD5.7 PERP | SGXF26579122 | 15-Jan-24 | | SGD | 450,000,000 |
| STTGDC SUSD3.1 28s | SGXF85905275 | 28-Jul-20 | 28-Jul-28 | SGD | 400,000,000 |
| STTGDC SUSD3.5 24s | SGXF20920694 | 26-Sep-19 | 26-Sep-24 | SGD | 225,000,000 |

**Case table 42.1** Outstanding STT GDC bonds. Source: Bloomberg

The Sustainability Performance Target (SPT) is to increase the percentage of electricity used from renewable sources from 43% in 2020 to 60% in 2026. Case figure 42.2 shows the reported data; the latest figure of 52% for 2022 comprises a total of 878 GWh of 'carbon-free electricity'. An additional renewables-focused Power Purchase Agreement (PPA) was signed in 2023 with O2 power, an Indian renewable energy platform, to supply STT GDC India.

Any trend of higher renewables usage has to be considered alongside STT GDC's business growth. From 2021 to 2022, STT GDC's total energy usage increased 22%, and its absolute renewable procurement increased 45%, which combined to achieve the 8% rise in the KPI. In general, the recent trend of increase would suggest that the SPT is relatively achievable.




**Case figure 42.2** STT GDC historic renewable energy usage. Source: STT GDC

A bullet SLB step-up coupon can be priced as a binary option using the probability of the target being missed as an input into the model.

When the underlying instrument is a perpetual, that adds a dimension of complexity into the pricing. Corporate hybrids are typically called at the first opportunity, and if not there is usually a coupon step-up to compensate investors, and the bond typically loses its equity content. In this example, the STT GDC hybrid coupons step up 100bps if not called, so we will price the bond to the first call date.

The unadjusted coupon is 5.7%, and the step-up coupon, of 25bps, is potentially paid for the final two-and-a-half years. Even before considering a credit-risky discounting, we can see this is not a material step-up. Using risk-free discounting and an illustrative 50% probability of missing the target, the total value is calculated to be worth 0.28%, well below the threshold needed to be considered a "greenback SLB" (see Chapter 2).

When modelling the variables, a renewables KPI is more complicated than one that is emissions-based. Historical data is generally scarcer, changes are typically more discontinuous, being driven by new infrastructure or contractual arrangements, and dynamics change when the variable is close to 0 or 100%. Here, due to very limited prior data, we estimate the probability of missing the target to be 25%. The trend suggests the company plans to meet the target some years ahead of the observation date, and there are news stories suggesting additional renewable power has been sourced. However, the ongoing growth of the business adds some uncertainty.

Using a 25% probability of missing the target, we calculate the total upfront value of the option to be 0.14%, which is 2.5bps running to the first call date. In the context of a subordinated bond priced at a spread of 298bps, this is immaterial.

STT GDC's CFO has reported that it was hard to identify a direct benefit to pricing from the sustainability features, however he feels it definitely contributed to a stronger execution process.

## 6.3 CONTINGENT RESILIENCE-LINKED (CORL) BONDS[7]

With an estimated USD1.8trn needed for climate resilience investments by 2030, and an associated USD7.1trn in economic benefits, it is both urgent and economically rational to catalyse synergies between public and private capital.[8] This section presents AFII's proposed CORL structure, which has the potential to be one such catalyst. The structure is unique in being able to deliver flexible credit enhancement to entice private capital.

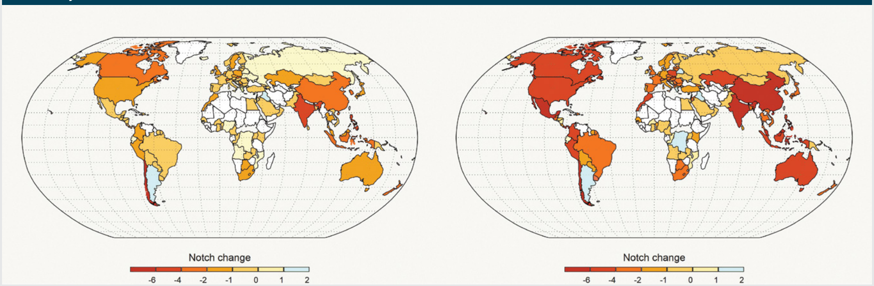
Finding effective ways to combine public and private capital in support of the UN SDGs is a key topic for global finance in general and fixed income in particular. One of the thorny issues has been that traditionally, economic analyses of climate change have produced relatively modest impact estimates on GDP and other macroeconomic variables. As a result, projections of credit deterioration for bond issuers have been minimal.

Times and analyses are both changing. In the 2021 paper, "Rising Temperatures, Falling Ratings: The Effect of Climate Change on Sovereign Creditworthiness",[9] the authors directly model climate impacts on credit ratings. This concludes that rating changes would vary across countries and be front-loaded in many cases (see Figure 6.1 ).[10] Another study, "Nature Loss and Sovereign Credit Ratings",[11] generated similar rating deltas but based on nature rather than climate change factors. These studies plough the same furrows as the present analysis, which is focused on rating changes and implications for bond pricing.

However, the implications of these and other empirical analyses may only crystalise over the long term, beyond most investors' standard time horizons. Perhaps more importantly, they do not describe how these downside scenarios can be navigated via investment processes. If economic risks, or risk reductions, are only hypothetically tied to investment outcomes, the potential synergies between public and private capital are less compelling to the individual investor.

As argued previously in this book, this is where GSSS bonds – including SLBs – come into play, as they seek to tie investment outcomes to some form of positive impact. In particular, the SLB structure seems well-suited for lower-rated, smaller issuers,[12] for whom the

**Figure 6.1** Global climate-induced sovereign rating changes (2100, Representative Concentration Pathways 2.6/ 8.5). Source: Klusak et al. (2023)




[7] This analysis was originally published as "Contingent Resilience-Linked (CORL) bonds: combining public and private capital for resilience", AFII, 31 Oct 2023.

[8] "Designing a climate resilience classification framework. To facilitate investment in climate resilience through capital markets", UNDRR, 2023.

[9] Klusak, P., Agarwala, M., Burke, M., Kraemer, M. and Mohaddes, K., Cambridge WP in Economics 2127.

[10] Other recent analyses around rating risks and climate risk effects include "Rating stability at risk from looming climate downgrades", IEEFA, 21 Aug 2023; "Barclays Warns of Bond Risk Few Creditors Are Pricing Right", Bloomberg, 4 Sep 2023.

[11] Agarwala, M., Burke, M., Klusak, P., Kraemer, M. and Volz, U., Finance for Biodiversity Initiative, July 2022.

[12] See "SLBs: complementary, my dear Investor", AFII, 13 Apr 2023.

underlying capital expenditure needed to achieve positive impact may be hard to attach to already existing assets.[13] Both green bonds and SLBs have the benefit of being tradeable in open, liquid markets, which provides them with access to broader pools of fixed income capital.

Recognising that SLBs have been almost entirely private capital market transactions to date, without the involvement of Development Financial Institutions (DFIs), there is interest in exploring ways to combine the former with public capital to make them appealing to general fixed income investors.[14]

To this end, this section uses the previously described SLB option pricing approach to develop what we call a Contingent Resilience-Linked (CORL) bond structure. Superficially, the CORL bond is a 'standard' SLB with a step-down, but one where a third party – e.g., a DFI – provides credit enhancement contingent on the achievement of an SPT. In practice, the DFI commits capital to achieve a higher recovery rate on the CORL bond in the case of SPT achievement and default of the issuer.

**The step-down CORL bond can price with a fixed coupon struck at the same interest rate as an equivalent vanilla bond if the step-down implies a credit improvement. This is important for creating an incentivising structure for the borrower. Furthermore, we show how this structure could in fact be attractive to all stakeholders, including DFIs.**

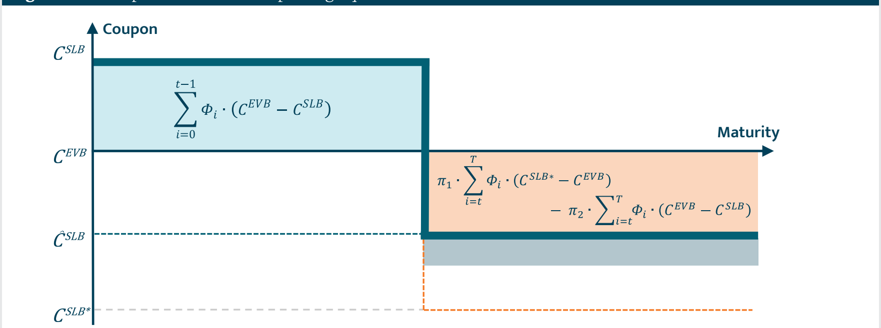
### 6.3.1 PRICING OF STEP-DOWN SLBS WITH CREDIT QUALITY AND SPT CORRELATION

Most SLBs have been issued as "vanilla" instruments. However, some recent issuances have catered for different capital and funding needs. These include SLBs structured as corporate hybrids, convertible bonds, and bank funding vehicles.

The notion of step-ups containing a stigmatising "penalty" on non-performance has shifted attention to step-down structures, where the achievement of the sustainability performance target is what is prized. However, SLBs with step-downs have one significant drawback: the fixed coupon must, all else being equal, surpass that of an equivalent vanilla bond (EVB) in order to be attractive to investors – and this is very unattractive to issuers.

**In a risk-neutral context, if we consider an EVB with a 5% coupon and compare it with an SLB that steps down (SLBD) by 0.5%, then that SLBD should have a fixed coupon of more than 5% in order to compensate investors for the potentially lower coupon in the future.** This dynamic is illustrated in Figure 6.2, and further explained in the pricing chapters of this book.

**Figure 6.2** Coupon structure and pricing equations in an SLBD. Source: AFII




[13] In terms of development finance, the difference between program and asset specific financing, and the need to shift to the former, is discussed in "How to finance a faster shift to a better world", Financial Times, 17 Oct 2023.

[14] To our knowledge, the only DFI-supported SLB so far has been a bond by Rwanda, see "World Bank Approves First Sustainability-Linked Bond for Rwanda to Boost Private Capital Mobilization", World Bank, 29 Sep 2023, with a reported small size, USD24.8mn. There have been a number of other sovereign SLBs, e.g. Chile ("Offi-Chile the largest sovereign SLB issuer", AFII, 29 Jun 2023) and Uruguay ("Uruguay SLB: market update", AFII, 5 Jun 2023).

A mathematical expression describing the relationship between the fixed coupon in the SLBD and the EVB can be derived using a simple no-arbitrage relationship:[15]

$$\sum_{i=0}^{t-1} \Phi_i \cdot (C^{EVB} - C^{SLB}) = \gamma_1 \cdot \sum_{i=t}^{T} \Phi_i \cdot (C^{SLB*} - C^{EVB}) - \gamma_2 \cdot \sum_{i=t}^{T} \Phi_i \cdot (C^{EVB} - C^{SLB})$$

where $\Phi_i$ is the risky discount factor for time $i$ (which runs from $0...t...T$ where $t$ is the step date[16] and $T$ is the maturity date), $C$ is the coupon for the *EVB*, the start date SLB and the stepped up *SLB**. The probability to step is denoted $\gamma_1$ with the non-step probability $\gamma_2=1-\gamma_1$.

**However, it may be difficult for an issuer's CFO to argue that they should pay a higher coupon ($C^{SLB}$) in the short term in exchange for the possibility of paying a lower one in the future.** But now consider merging this with our discussion on switching risk curves in Chapter 5, specifically Table 5.3. We know that an investor sees more value in a bond traded against a lower risk curve, for the simple reason that they are more likely to have the full nominal value of the bond returned. Can we use this perception to frontload a lower SLBD coupon? The answer is 'yes'.

Consider Table 6.2 where we describe an SLBD with a fixed 7.25% coupon and allow it to drop by 0.1% (10bps) if a sustainability target is met. We assume that achievement of this target and the associated step-down is correlated with an improvement in creditworthiness, delivered for example

**Table 6.2** Pricing an SLBD with 7.25% fixed coupon, a 0.1%/0.57% step-down after year five, and split (BB/BBB) discount curves. Source: AFII

| | BB BOND | | | | BB 1-5Y, BBB 5-10Y, SD -0.1% | | | | SD -0.57% |
|---|---|---|---|---|---|---|---|---|---|
| YEAR | SPOT RATE | DISC. FACTOR | DISC. COUPON | DISC. NOMINAL | SPOT RATE | DISC. FACTOR | DISC. COUPON | DISC. NOMINAL | DISC. COUPON |
| 1 | 6.87 | 1.069 | 6.784 | | 6.87 | 1.069 | 6.78 | | 6.78 |
| 2 | 6.85 | 1.142 | 6.350 | | 6.85 | 1.142 | 6.35 | | 6.35 |
| 3 | 6.85 | 1.220 | 5.943 | | 6.85 | 1.220 | 5.94 | | 5.94 |
| 4 | 6.89 | 1.305 | 5.555 | | 6.89 | 1.305 | 5.55 | | 5.55 |
| 5 | 6.97 | 1.400 | 5.177 | | 6.97 | 1.400 | 5.18 | | 5.18 |
| 6 | 7.09 | 1.508 | 4.807 | | 7.00 | 1.501 | 4.76 | | 4.45 |
| 7 | 7.20 | 1.627 | 4.455 | | 7.04 | 1.610 | 4.44 | | 4.15 |
| 8 | 7.31 | 1.759 | 4.123 | | 7.10 | 1.731 | 4.13 | | 3.86 |
| 9 | 7.42 | 1.904 | 3.808 | | 7.16 | 1.864 | 3.84 | | 3.58 |
| 10 | 7.53 | 2.067 | 3.508 | 48.38 | 7.23 | 2.011 | 3.56 | 49.74 | 3.32 |
| BPC | | | 50.51 | 48.38 | | | 50.54 | 49.74 | 49.17 |
| **BOND PRICE** | | | | **98.89** | | | | **100.27** | **99.90** |

[15] An explanation of this pricing relationship and the graphs is available in "greenback SLBs: an impact standardisation proposal", AFII, 10 May 2023.

[16] In the earlier parts of the book, the index for time was $t=0...\tau...T \Leftrightarrow$ replaced by $i=0...\tau...T$ here.

via credit enhancement from a third party. This allows us to assume a BBB discount curve after year five. This SLBD would price at 100.27, meaning that it would be more attractive than the BB-rated bond without the credit improvement (but also without a step-down). The lower risk discount curve more than compensates for the lower coupons for the investor.

Indeed, if we price the SLBD such that it is equal in value to the original EVB, we can set the step-down at -0.57%, as indicated in the rightmost column of Table 6.2. This means that – under the condition that the bond risk switches to BBB after the step-down date – the investor would be agnostic about investing in the SLBD or EVB.

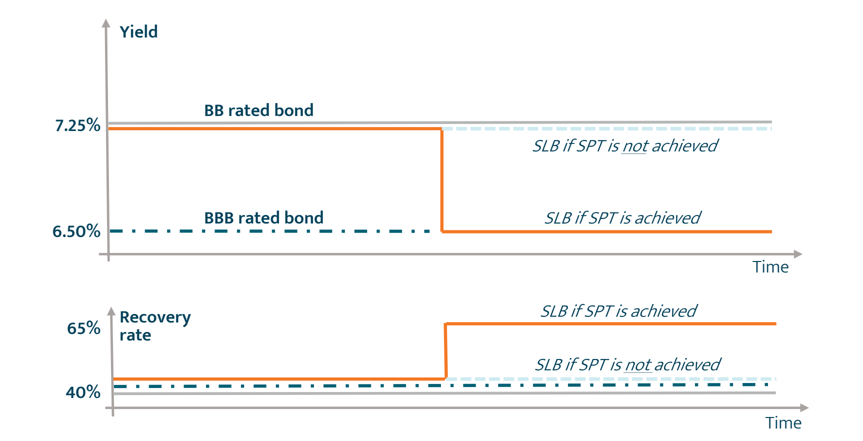
Here it is important to note that, as our baseline pricing measure is the price of non-structured bonds, the step probability of the SLB does not matter for the pricing of the bond.

The key here is the embedded potential for an improvement of creditworthiness and associated switch in discount curves. If the investor is 100% certain that the achievement of a certain SLB target will also derisk the bond, the analysis is fairly straightforward. But this level of certainty is unlikely, because although the empirical evidence is promising it is in no way definitive. This is where third parties could be involved: providing credit enhancement to hardcode that SPT achievement results in a switch of discounting curves.

### 6.3.2 CORL: CREDIT ENHANCEMENT CONTINGENT ON SPT PERFORMANCE

The CORL bond concept, which draws on this idea of hardcoding a switch in discount curves, is presented in Figure 6.3. Here the credit enhancement is formatted to deliver an automatic increase in recovery rate in case of default, but only if the SPT has been achieved (the bottom panel of the figure). The (contingent) derisking of the bond thus becomes certain for the investor.

**Figure 6.3** Conceptual relationship between step-down and enhanced recovery rate in the CORL structure. Source: AFII



Translating Figure 6.3 into a mathematical expression, we incorporate historical loss-given-default (LGD) rates and probability of default (PD) rates within rating categories. We start by assuming the following simple relationship:

$$P^{BB} - E(L^{BB}) = P^{AAA} \leftrightarrow P^{BB} = P^{AAA} + E(L^{BB})$$

i.e. the price (present value of cash flows) of the BB-rated bond, $P^{BB}$, is equal to the price of the risk-free bond, *P*, plus the (present value of) expected loss of the BB-rated bond, $E(L^{BB})$. We assume a zero risk-premium here. We furthermore define the expected loss as:

$$E(L^{BB}) = PD^{BB} \cdot LGD^{BB} = \pi^{BB} \cdot (1 - R)$$

where $PD^{BB}$ is the probability of default for the BB-rated bond and $LGD^{BB}$ is the loss-given-default. Loss-given-default is alternatively defined as (1-*R*), where *R* is the recovery rate for the bond. We will assume, unless otherwise stated, that *R* is 40%, and that it is equal across rating categories.

If we assume that same notation for a BBB-rated bond, we can write the price of the BB-rated bond as a function of the price of the BBB-rated bond, and the incremental expected loss between BB and BBB:

$$P^{BB} = P^{BBB} + [E(L^{BB}) - E(L^{BBB})] \leftrightarrow r^{BBB} = r^{BB} - [E(L^{BBB}) - E(L^{BB})]$$

In other words, the price of the BB-rated bond is simply the price of the BBB-rated bond plus the expected (increased) loss on the BB-rated bond.

Now, suppose there is an $R^*$ such that

$$E(L^{BBB}) = PD^{BBB} \cdot LGD^{BBB} = \pi^{BBB} \cdot R = \pi^{BB} \cdot R^*$$

This $R^*$ is the recovery rate which would be required in order to match the expected loss of a BBB-rated bond, but assuming a BB default probability.

This means that if we improve the recovery rate on the BB-rated bond, to $R^*$, we can create a BBB-rated asset – the investor should be indifferent to a higher probability of default and a lower loss rate, or a lower default rate and a higher recovery. This is a common credit enhancement mechanism: the guarantor does not lower the probability of default but covers losses in case it happens.[17]

[17] Note that not all credit ratings agencies use loss-given-default in their rating assessments. This means that one rating agency would likely consider an asset with a 100% recovery rate as nearly risk-free and have as high a rating as the credit enhancement provider, whereas another would rate it significantly lower, just looking at the probability of default. An illustrative example of this is: "Norway's Eksportfinans Cut to Junk by Moody's Amid Wind Down", Bloomberg, 22 Nov 2011.

**Table 6.3** Pricing the BB-rated bond with changing recovery assumptions to analyse credit enhancements. Source: AFII

| YEAR | BBB BASE CASE | BB BASE CASE | BB WITH 58% RECOVERY | BB WITH 93% RECOVERY | BB WITH 100% RECOVERY |
|---|---|---|---|---|---|
| 1 | 0.38 | 2.087 | 3.026 | 4.866 | 5.218 |
| 2 | 0.27 | 1.403 | 2.035 | 3.272 | 3.509 |
| 3 | 0.26 | 1.355 | 1.965 | 3.160 | 3.389 |
| 4 | 0.20 | 0.508 | 0.737 | 1.185 | 1.271 |
| 5 | 0.19 | 0.486 | 0.705 | 1.134 | 1.216 |
| 6 | 0.11 | 0.215 | 0.312 | 0.502 | 0.539 |
| 7 | 0.10 | 0.204 | 0.295 | 0.475 | 0.509 |
| 8 | 0.24 | 0.284 | 0.412 | 0.663 | 0.711 |
| 9 | 0.22 | 0.266 | 0.385 | 0.620 | 0.664 |
| 10 | 0.20 | 0.242 | 0.351 | 0.564 | 0.605 |
| SUM R | 2.19 | 7.05 | 10.23 | 16.44 | 17.63 |
| DISC. NOMINAL | 54.446 | 46.426 | 46.426 | 46.426 | 46.426 |
| COUPON STREAM | 54.580 | 48.346 | 48.346 | 48.346 | 48.346 |
| **BOND PRICE** | **111.215** | **101.824** | **104.997** | **111.212** | **112.402** |

Now consider a worked example of this: a third party commits to cover some of the losses of the investor in case of default of a BB-rated bond. This means that the investor will get the improved recovery rate $R^*$ vis-à-vis the non-enhanced case in a default event. Default probabilities $\pi^{BB}$ themselves are not affected; it is only the "expected recovery" leg that is altered in our calculations. We tabulate this in two versions in Table 6.3.

First, we look at setting the value of the recovery such that the two legs of the BB and BBB are equal. In other words, what are the recovery rates such that the investor is indifferent between the BBB-rated and BB-rated bond in terms of return of nominal amounts, but excluding coupon payments? This happens at an $R^*$ = 58% recovery rate (i.e. an 18% credit enhancement), with a bond price of 104.997 (middle column of Table 6.3).

Second, we look at what recovery rate the investor would be all-in indifferent between the BBB-rated and BB-rated bond, including both the value of the coupon streams as well as the notional as discussed above. In other words, at what recovery rate does the BB-rated bond price equal to that of the BBB-rated bond? The answer in this example is approximately 93.25%. This does not seem intuitive. With an almost 100% assured recovery rate, the BB investor is no better off than the BBB investor. Central to this conclusion are two assumptions. One, that the BB investor would be cut off from the stream of high-coupon payments associated with that credit, and two, that they invest the recovered nominal at the risk-free rate.

An important decision here is whether the credit enhancement should cover nominal repayments only, or also cover the (lower) likelihood of receiving the full coupon stream. Here we opine that the first option should apply: an investor should only look for credit enhancement to target a certain expected loss $E(L^{BBB})$, and reinvestments of any recoveries should be decided by the investor.[18]

We will now assume that credit enhancement is provided by concessionary capital amounting to $R^* - R$, and then analyse two implementations. In the first version, the

[18] A special case arises when credit enhancements provide 100% recovery. Then the investor will, in case of default, be able to reinvest the full notional again, in some other asset yielding what the original coupon of the bond was, which would appear a good outcome for the investor compared to holding a straight BBB bond. As illustrated in Table 6.3, the 100% recovery BB bond only prices 1.2 points above the BBB bond with 40% recovery, which seems relatively small. This illustrates the assumption in the pricing model that the recovery is not reinvested.

enhanced recovery rate is offered across the whole life of the bonds (non-contingent; NC); and in the second instance, the enhanced recovery is only offered if the SPT has been achieved (contingent, C). Going back to the earlier discussion, the latter case corresponds to when an investor views the SLB as BBB-rated in case of SPT performance, and BB-rated otherwise. This then allows us to price in the possible step-down that could be 'offered' in the SLB structure to the issuer, given various credit enhancements, while still holding the SLB fixed coupon at the same level as the EVB.

To illustrate this, consider the bond pricing approach in Table 6.3 above, where we had a BB-rated bond with a 40% recovery pricing at 101.824. Using the same structure, but applying a step-down of 1% (and holding the SLB fixed coupon at the EVB level, 7.25%), the resultant bond price is 99.044. In this instance, therefore, the step-down structure would not be attractive to the investor. This is case (B) in Table 6.4.

We then seek the $R^*$ that would equalise the expected loss of the BBB- and BB-rated bond, non-contingent and then contingent on the bond having stepped down. This can be done via simple numerical search, and as the results in the rightmost section of Table 6.4 show, we find the first number to be 56% at a -1% step-down (case (C) in the table).[19]

At that assumed "enhanced" recovery rate, the SLB step-down structure is pricing just above (i.e., is more attractive than) the straight BB-rated bond, at 101.865 versus 101.824. In the second case, we assume a -0.25% step-down, and a contingent enhanced recovery of 63%, again seeing that this prices at 101.825, slightly above the EVB.

**Put simply, with a relatively modest amount of contingent credit enhancement, an SLB step-down bond with a fairly high (and incentivising) step-down would price equal to a straight non-step bond.** Indeed, if we look at the proposed structure and assume a 50% step probability, then the option value is

**Table 6.4** Pricing the BB bond (A), with a step-down structure (B), and a step-down structure but with higher recovery rate throughout the life of the bond (C), and with a step-down and contingent recovery rate (D). Source: AFII

| | (A) VANILLA BB BOND | | (B) -1.0% STEPDOWN | | (C) -1.0% SD AND 56% NON-CONT. RECOVERY | | (D) -0.25% SD AND 63% CONTINGENT RECOVERY | |
|---|---|---|---|---|---|---|---|---|
| YEAR | DISC. COUPON | EXPECTED RECOVERY | DISC. COUPON | EXPECTED RECOVERY | DISC. COUPON | EXPECTED RECOVERY | DISC. COUPON | EXPECTED RECOVERY |
| 1 | 6.500 | 2.087 | 6.500 | 2.087 | 6.500 | 2.922 | 6.500 | 2.087 |
| 2 | 5.989 | 1.403 | 5.989 | 1.403 | 5.989 | 1.965 | 5.989 | 1.403 |
| 3 | 5.539 | 1.355 | 5.539 | 1.355 | 5.539 | 1.898 | 5.539 | 1.355 |
| 4 | 5.239 | 0.508 | 5.239 | 0.508 | 5.239 | 0.712 | 5.239 | 0.508 |
| 5 | 4.925 | 0.486 | 4.925 | 0.486 | 4.925 | 0.681 | 4.925 | 0.486 |
| 6 | 4.637 | 0.215 | 3.997 | 0.215 | 3.997 | 0.302 | 4.477 | 0.339 |
| 7 | 4.348 | 0.204 | 3.748 | 0.204 | 3.748 | 0.285 | 4.198 | 0.321 |
| 8 | 4.058 | 0.284 | 3.498 | 0.284 | 3.498 | 0.398 | 3.918 | 0.448 |
| 9 | 3.745 | 0.266 | 3.228 | 0.266 | 3.228 | 0.372 | 3.616 | 0.419 |
| 10 | 3.366 | 0.242 | 2.902 | 0.242 | 2.902 | 0.339 | 3.250 | 0.381 |
| BPC | 48.346 | 7.052 | 45.566 | 7.052 | 45.566 | 9.873 | 47.651 | 7.749 |
| **BOND PRICE** | | **101.824** | | **99.044** | | **101.865** | | **101.825** |

[19] Obviously, the step-down and necessary recovery rate are jointly determined. The 1% step-down is assumed in order to find the corresponding enhanced recovery required.

USD1.39 in bond price terms, which is clearly above the "greenback SLB" threshold.[20]

These results answer the following question: what would the cost be of providing credit enhancement such that the SLB step-down structure is considered BBB-rated?

Numerically, as shown in case (C) in Table 6.4, the cost of providing 56%-40% = 16% credit protection (which lifts the bond from BB to BBB in terms of expected loss in the stepdown scenario) in case of default is 101.865 – 99.904 = 2.821. In other words, less than 3% of bond notional in net present value terms. From the perspective of a DFI, that would be the amount to book upon the issuance of the bond. Of course, if default does occur, the payout would be 16% of bond notional – but this sum is heavily discounted both through time discounting as well as actual default probabilities.

Finally, in case (D) in Table 6.4, we look at how much credit enhancement is necessary for a certain step-down level if credit enhancement is contingent on the SPT being achieved. In other words, the enhanced recovery rate only gets paid out in case of the sustainability/resilience target having been achieved. In the (D) case, we assume a 25bps step-down, and in that case require a 63% (23% credit enhancement) recovery rate in order to price the structure flat to the EVB. Making the credit enhancement contingent on SPT achievement reduces the potential step-down, but also the expected cost to the credit protection provider.

In Table 6.5, we calibrate the contingent and non-contingent structures further. Case (E) explores how big a step-down and what sort of enhanced recovery would be necessary to make the structure "greenback", i.e. the optionality of the structure being at least USD1/1% of the bond price (see Chapter 2), assuming a 50% probability of the step happening. Case (F) combines both a non-contingent credit enhancement (5% to 45% recovery), and a contingent one (23% enhancement, to 63% recovery). Both these cases illustrate how the structure can be flexibly adapted to target a particular step-down size, option value, or mix of parameters.

**Table 6.5** Calibrating CORL structures: (E) represents a non-contingent structure aligning with a greenback definition (USD1 of option value); (F) is a hybrid structure with both non- and contingent credit enhancements at 5% and 23% respectively. Source: AFII

| YEAR | (E) "GREENBACK" CORL SD -0.72% SD 52% NON-CONTINGENT RECOVERY<br>DISC. COUPON | EXPECTED RECOVERY | (F) CORL SEMI-CONTINGENT SD -0.50%, 45% NCR, 63% CONTINGENT R<br>DISC. COUPON | EXPECTED RECOVERY |
|---|---|---|---|---|
| 1 | 6.500 | 2.713 | 6.500 | 2.348 |
| 2 | 5.989 | 1.824 | 5.989 | 1.579 |
| 3 | 5.539 | 1.762 | 5.539 | 1.525 |
| 4 | 5.239 | 0.661 | 5.239 | 0.572 |
| 5 | 4.925 | 0.632 | 4.925 | 0.547 |
| 6 | 4.176 | 0.280 | 4.317 | 0.339 |
| 7 | 3.916 | 0.265 | 4.048 | 0.321 |
| 8 | 3.655 | 0.370 | 3.778 | 0.448 |
| 9 | 3.373 | 0.345 | 3.486 | 0.419 |
| 10 | 3.032 | 0.315 | 3.134 | 0.381 |
| BPC | 46.344 | 9.168 | 46.956 | 8.479 |
| **BOND PRICE** | | **101.938** | **101.860** | |

[20] A "greenback SLB" is where the risky discounted value of the coupon step stream is more than USD1 in bond price terms, and where a 50% probability of step is assumed, see the final section of Chapter 2.

So far, we have only considered what implicit rating effects have in terms of loss-given-default, treating default probabilities themselves as exogenous. In practice, we have assumed that the issuer follows a BB default rate probability pathway irrespective of the implementation of resilience measures. What happens if we start assuming that default probabilities decrease as these measures are implemented?

Our first example of this is shown in case (G) in Table 6.6, where we assume that the CORL bond follows a BB default trajectory the first five years, but that the then-marginal default probabilities follow the pattern of a BBB rating after the achievement of the SPT.[21] Assuming a 63% contingent recovery rate, like in case (D) in Table 6.4, we can infer that the corresponding step-down should be 37bps compared to 25bps in that case, where we assumed a simple BB default trajectory. The improved default trajectory changes the possible step-down size significantly.

Next, we re-run the above framework but assuming that the BB-rated bond improves such that it starts following a BB+ trajectory. In order to derive default probabilities for the BB+, we linearly interpolate the BB versus BBB default probabilities (see leftmost column of Table 6.6). First, case (H) in Table 6.6 prices an EVB at the BB+ level to 104.594, compared with 111.215 for the BBB-rated bond in Table 6.3. This difference can be construed as potential profit (approximately 104.59-101.82=2.8 points) for an investor who has bought into structures (C)-(F) described in the tables, so long as either of those structures leads to a fundamental improvement of credit quality to BB+.

But if there is an inherent credit improvement, one can argue that the spoils should be split between the issuer, the DFI, and the investor, rather than ending up solely with the investor. Now assume that an external credit rating agency would consider re-rating the CORL structure from BB to BB+ if there is a higher recovery, and a potentially lower interest rate payment. Clearly, there would have to be a discussion between the DFI (as credit enhancement provider) and the rating agency, to see how much enhancement is needed in order to secure a rating notch uplift on

**Table 6.6** Repricing the bond structures under the assumption of an improved default trajectory, equivalent to moving from BB flat to BB+. Source: AFII.

| | | | (G) HYBRID BB(1-5)/BBB(6-10) SD -0.37% CONT. 63% RECOVERY | | | (H) BB+ EVB | | | (K) BB+ UPGRADE, SD -1.25% CONT. R 60% | |
|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | BB+ RATE | BB/BBB. HYBRID DEF. R. | NOMINAL | DISC. COUPON | EXPECTED RECOVERY | NOMINAL | DISC. COUPON | EXPECTED RECOVERY | DISC. COUPON | EXPECTED RECOVERY |
| 1 | 4.0% | 5.5% | | 6.500 | 2.087 | | 6.603 | 1.518 | 6.603 | 1.518 |
| 2 | 6.8% | 9.4% | | 5.989 | 1.403 | | 6.157 | 1.027 | 6.157 | 1.027 |
| 3 | 9.6% | 13.2% | | 5.539 | 1.355 | | 5.766 | 0.992 | 5.766 | 0.992 |
| 4 | 10.8% | 14.7% | | 5.239 | 0.508 | | 5.477 | 0.407 | 5.477 | 0.407 |
| 5 | 12.0% | 16.2% | | 4.925 | 0.486 | | 5.170 | 0.389 | 5.170 | 0.389 |
| 6 | 12.6% | 16.6% | | 4.418 | 0.170 | | 4.876 | 0.180 | 4.035 | 0.269 |
| 7 | 13.2% | 16.9% | | 4.161 | 0.160 | | 4.580 | 0.170 | 3.790 | 0.255 |
| 8 | 14.2% | 17.8% | | 3.892 | 0.376 | | 4.280 | 0.269 | 3.542 | 0.404 |
| 9 | 15.2% | 18.6% | | 3.599 | 0.351 | | 3.955 | 0.251 | 3.273 | 0.377 |
| 10 | 16.1% | 19.5% | 47.128 | 3.242 | 0.320 | 49.099 | 3.560 | 0.229 | 2.946 | 0.343 |
| BPC | | | 47.128 | 47.506 | 7.217 | 49.099 | 50.424 | 5.431 | 46.760 | 5.980 |
| **BOND PRICE** | | | | | **101.851** | | | **104.954** | | **101.840** |

[21] This default trajectory is shown as "BB/BBB hybrid default" in the table.

the structure. Here, we assume that a 20% contingent recovery enhancement (to an expected recovery rate of 60%) combined with a step-down of -1.25%, in combination with a compelling SPT, would suffice to achieve the one notch uplift.

This resulting pricing is shown in case (K) in Table 6.6. The structure would be valued at 101.84, just slightly above the BB-rated vanilla bond. **The possible large step-down (125bps) in this case is a function of the large impact default probability trajectories (and improvements thereof) on the valuation of the bond.** Having a view that the structure equates a one notch of uplift does generate a lot of value, and the potential for more ambitious step pricing.

The structures (G) and (K) are what we could call true Contingent Resilience Linked (CORL) bonds. Credit enhancement is only contingent on SPT performance; however, it is strong enough to improve the credit rating and/or underlying default expectation assumption, which is core to the concept of the investment's resilience.[22]

### 6.3.3 CORL BOND: STAKEHOLDER ANALYSIS

Four distinct stakeholders have to align for a CORL structure to succeed: the issuer, investors, the DFI, and the rating agency.

**The issuer** has the most obvious interest in this structure, as the step-down offers a free – or at least a very cheap – option to pay a lower interest rate. The step-down also incentivises resilience actions without the constraints applied through traditional asset-focused financing, like green bonds. Sovereign issuers may also benefit from the structure's ability to lock in ESG/resilience policy beyond electoral cycles. Indeed, this feature may incentivise greater resilience expenditure in and of itself.

CORL issuers may further benefit from access to private investor and DFI technical support on resilience that may otherwise not be available to them. Suppose the CORL SPT is linked to flood defences and there is a need for spatial examinations to monitor flooding resilience improvements. A DFI and investors may offer to facilitate this monitoring, as the data gathered would be relevant for valuing their own exposures.[23]

The CORL structure may also grant the issuer access to capital otherwise shut off to them. Large asset owners are typically unable to invest in debt without an investment grade rating. The CORL structure could allow issuers close to the investment grade threshold access to these investors, thanks to the credit enhancement feature.

As for **investors,** a CORL structure could be highly attractive where the DFI credit enhancement is sufficient to balance out the lower coupon stream in the event of a step-down. Any correlation between the issuer's achievement of a resilience SPT and its creditworthiness will further increase the bond price, producing P&L benefits for the investor.

Investors may also reap non-pecuniary benefits. These can range from better impact reporting to improved real-world resilience outcomes. There are possible business advantages to be gained, too. For example, it may be possible to include well-defined CORL bonds in dedicated sustainability funds, e.g. those labeled under the EU's SDFR Article 8 and 9 categories.[24]

In order to invest in CORL structures, investors will have to be convinced that the rating uplift is reasonable for the given level of resilience improvement (in the example of case (H)) and have a degree of confidence in their understanding of realised versus historical default rates and realised versus assumed recovery rates. This is demanding, yet also close to traditional credit analysis.

For the **DFI** or other concessionary capital provider, if it is assumed they have other, non-CORL exposures to the issuer, then the

[22] It has not been discussed here, but an analogous point could be made around potential credit rating deterioration.

[23] For a practical example of this, see "The Forensic Carbon Accountant: JBS SLB", AFII, 21 Sep 2023.

[24] There is an ongoing debate on whether SLB structures are eligible for inclusion under such regulations. Our understanding is that the source of confusion may lie in the potential impact of the instrument: if the potential impact is more robust – as suggested in these CORL structures – our discussions with related regulatory parties indicate that inclusion should be possible.

CORL structure could incentivise resilience improvements that lower all these exposures simultaneously.

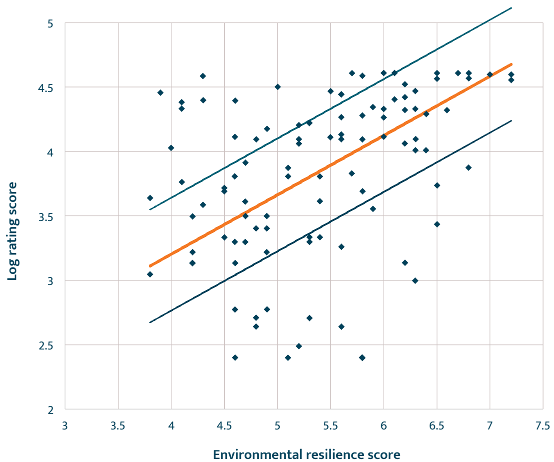
Consider the following example/analogy:

*An insurance company is providing flood insurance to a municipality where the magnitude of insurance premiums to be paid is hard to define and/or monetise.[25] If the municipality implements measures to reduce flooding risks, then the insurance company can expect a lower future loss rate, which is an economic gain for the insurance company. This gain can then be used to counterbalance the provision of concessionary capital in a CORL structure. The insurance company would step in to provide the contingent credit enhancement in a CORL with targets based on flooding resilience metrics, thus providing longer-term incentives to implement such measures for the municipality issuer as well as crowding in private capital interest into the policy.[26]*

Of course, the DFI would also benefit from the same non-pecuniary factors gained by the investors. These entities typically have performance metrics linked to the UN SDGs or other climate and environmental targets, which CORL structures may count toward. On the flipside, a DFI could be adversely affected if resilience measures are not taken by the CORL issuer. In such instances, questions may be asked of the DFI as to why it was not directly involved in financing these measures.

Perhaps the most attractive feature of the CORL structure to the DFI is how it allows for efficient allocation of its limited capital. Going back to our example of a BB/BBB CORL structure above, a USD500mn transaction would require a DFI to book only 3% notional = USD15mn exposure today.[27] We believe the ratio between financing raised and current exposure USD500mn/USD15mn at 33x should be appealing in terms of improving capital efficiency.

**Figure 6.4** Environmental resilience score vs (natural log) rating score. Regression line based on a Total Least Squares/ orthogonal regression, 0.75 standard deviation two-sided confidence intervals in grey. Source: Fund For Peace State Resilience Index, Bloomberg, AFII, UNDRR.




[25] Regulatory reasons may, for example, make it difficult to differentiate premium payments from various sub-government entities.

[26] Data provisioning and SPT construction seem to be a feasible exercise in the area of flooding exposures, see "Global evidence of rapid urban growth in flood zones since 1985", Rentchler et al, Nature 622, 87.92. (2023). The paper does highlight the conflict between better flood protection and urban planning, which we argue above are better suited to target through GCP rather than UOP bonds.

[27] In this example, the payout exposure in case of a default when the SPT has been achieved would be USD85mn, which has a net present value (discounted for the probability of it happening) of USD15mn.

Finally, the **rating agency** plays a role implicitly in the structure outlined in case (H). Here, it could formally signal an improvement to the issuer's credit once the SPT is reached, leading to an even greater pricing uplift for the CORL bond. We note that rating agencies have been paying increasing attention to nature-related risks, meaning such a credit action should not be beyond the pale.[28]

It does, however, still seem that environmental resilience has some way to go in terms of its impact on creditworthiness, as indicated in Figure 6.4. As an example, Paraguay (rated BB+/BB/Ba1) scores high on environmental resilience and could be expected to have a credit ratings upside if that resilience played a bigger role in terms of the rating.[29]

We also believe that rating agencies have the best data and expertise to gauge default risks over the longer term, and their role in terms of knowledge input in CORL structure development would be a clear advantage.

### 6.3.4 CORL CALIBRATIONS AND CAVEATS

The above CORL discussion is conceptual and will of course need to address several calibrations and caveats prior to implementation:

- **Default rates and recoveries:** We have used a rather coarse historical dataset of expected defaults and associated losses. With more granular data on ratings and underlying default probabilities, a more detailed analysis should be possible.
- **Point-in-time SPTs:** A natural question is: "What happens once the issuer has achieved the SPT and then loses the incentive to continue with resilience investments?" First, one could consider pricing the CORL bond based on a series of SPT "tests" rather than a single point-in-time SPT. This is feasible, although we would have some concerns that additional complexity may reduce investor appetite – for example, asset owner mandates sometimes exclude structured products, which this variation could be considered to be. We also believe that the SPTs may encourage the issuer (and to some extent the DFI) to extend possible maturities on future issuances of bonds. As the underlying projects and targets may not be reasonable to meet within a short timeframe, this particular discussion with investors could probably be anchored further out on the maturity curve than would be possible with a vanilla bond.[30]
- **Rates and curve sensitivity:** Our pricing examples have taken the current shapes of the risk-free and risky curves as the bases for the pricing analyses. These curves, and specifically their shape, will have first and second order effects on the valuations of the CORL structure. In particular, we note that curves are currently very flat or even inverted in some parts, meaning that discount factors in the front-end are relatively high compared to the backend.
- **Probability for SPT achievement and ambition level of the SPTs:** As shown in the pricing chapters, the core valuation factor in a "traditional" SLB structure is the step probability. In this section, we have not elaborated on the step-down probability as we have calibrated pricing such that the investor is indifferent from a financial standpoint as to whether the step happens or not. However, once we start assuming a correlation between achievement of the SPT and the creditworthiness (or inversely, default probabilities), then the step probability becomes more relevant. In practice, investors should ask for an ambition and target level from issuers that is most likely to lead to a creditworthiness improvement.

[28] See for example "Nature risk is material. And measurable", S&P Global Ratings website, accessed 27 Oct 2023; "Moody's Has a $1.9 Trillion Warning Over Biodiversity", Bloomberg, 28 Sep 2022; "Climate Physical Risks to Sovereigns Growing", Fitch Ratings, 23 Nov 2021.

[29] As an example bond from the issuer, consider PARAGUAY USD5.85 08/33 (USP75744AM75), trading at yield of 6.98% (27 Oct 2023).

[30] "You are a higher-risk borrower and we think it makes sense to lend money to you for three years, then we can have a renewed discussion (roll the debt)" would be a hypothetical argument from private investors in a vanilla bond. In a CORL structure, the valid counterargument would be, "we need to borrow at a slightly longer term in order to have the target SPTs, and start accruing the benefits from that, and this will also benefit you as an investor."

From the perspective of the DFI, there are counterbalancing forces: the lower the step probability, the lower its expected liability in terms of having to pay out the credit enhancement (with the contingent provision of a higher recovery rate for investor). This should translate to the DFI seeking SPTs that are as ambitious and demanding as possible, in order to minimise future 'insurance' payouts.

On the issuer front, the inclination will be to maximise the step-down probability by seeking the most unambitious targets possible. Sovereign issuers could be an exception, as in order to lock in policies across the electoral cycle they may pursue more ambitious targets.

Ultimately, investors may be the best arbiters of SPT ambition. They should seek an SPT that generates the maximum improvement in terms of underlying creditworthiness, which makes sense given they are the primary providers of at-risk capital. Note that this level of ambition is likely to be midway between the highest and lowest possible levels, balancing achievability with meaningful resilience improvement.

# CASE STUDY 43
## A CORL BOND PROPOSAL: MOROCCO

**RESEARCH: UNPUBLISHED AFII ANALYSIS, DEC 2023**

Morocco was hit by earthquakes in October 2023, with an estimated financing of USD11.7bn required for rebuilding efforts. Being in close proximity to Europe and a major waypoint for migration, supporting Morocco's rebuild could be of particular importance to European development finance organisations.

Morocco has two resilience priorities: quake-proofing new and old construction, and mitigating/adapting to significant water stress.

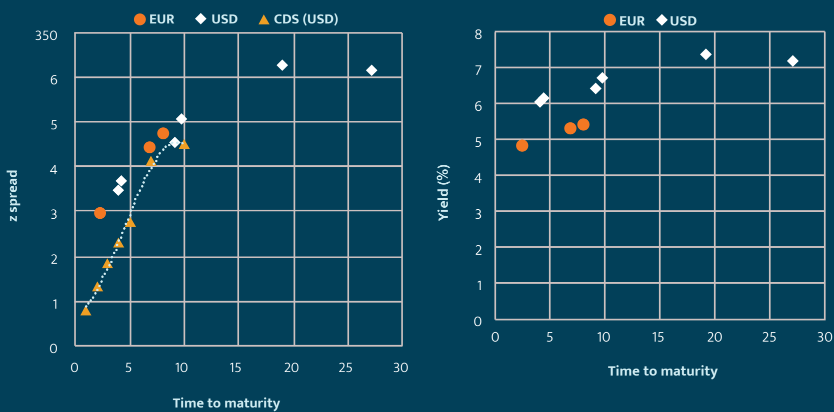
### BASED ON THIS, THE FOLLOWING DIRECTION FOR SPTS COULD BE:

- % of total real-estate stock built with earthquake resilience, spatial monitoring
- Water stress metrics (see New World Bank Program in Morocco Supports Efforts to Boost Water Security and Resilience for all)

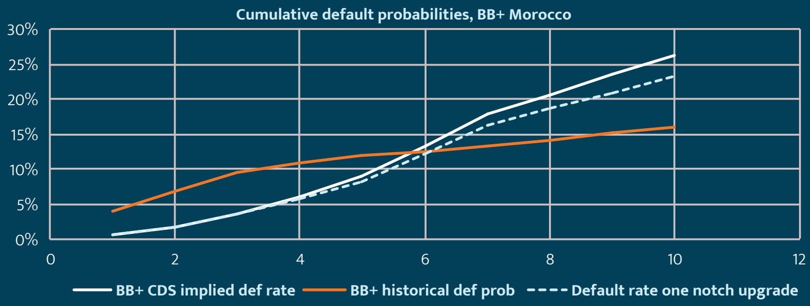
GCP bonds are better suited to get holistic strategies in place, rather than asset specific targets.

- Flexible with regards to population growth (new building expansions vs rebuilding), choice of de-risking strategies (e.g. lower density housing vs reinforced buildings; desalination vs water conservation).
- Structure "forces" continuous monitoring of progress versus targets.

Currently, Morocco has USD9.5bn outstanding across the curve, in EUR and USD. 5-10s curves are steep, as shown in Case figure 43.1 In spread terms, EUR and USD curves appear to price on top of each other.




**Case figure 43.1** (left) Credit spreads and bond yields; (right) on the Morrocco curve. Source: Bloomberg, AFII. Pricing data Nov-2023




**Case figure 43.2** Morocco CDS implied default rate. Source: Bloomberg, AFII

We will look at a hypothetical 10y EUR transaction where the closest EUR comparable is the 8yr 1.5% 11/2031, and in USD the 6.5% 09/33. On z-spread terms they trade 17bps apart, as in Case figure 43.1

In order to risk-discount the CORL cash flows, we use the cumulative default probability implied by the CDS curve, as shown in Case figure 43.2 This differs significantly from historical BB+ default rates, by backloading default risk. The market's view seems to be that default risk is backloaded and that is where "protection" is most valuable.

We price the MOROC bond as BB+ (implied default probabilities from CDS curve) assuming a 25% non-contingent recovery rate (NCR) (and using a 5.5% coupon) → **101.687.**

We then interpolate a BBB- default rate curve as per previous graph, and price the bonds with that risk-profile → **103.785.**

How much enhanced recovery would we need in the BB+ bond in order to make it as valuable as the BBB- bond? We goal-seek the recovery rate to 35%, yielding a bond price just above that of the BBB- bond → **103.863.**

| | 10Y MOROC EVB, NCR25% | | | BBB- WITH NCR25% | | | BB+ WITH NCR35% | | | SLBD, -1.0%SD, NCR25% | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | DISC COUPON | EXP RECOVERY | NOMINAL | DISC COUPON | EXP RECOVERY | NOMINAL | DISC COUPON | EXP RECOVERY | NOMINAL | DISC COUPON | EXP RECOVERY | NOMINAL |
| 1 | 5.262 | 0.140 | | 5.264 | 0.131 | | 5.262 | 0.195 | | 5.262 | 0.140 | |
| 2 | 5.043 | 0.292 | | 5.049 | 0.273 | | 5.043 | 0.409 | | 5.043 | 0.292 | |
| 3 | 4.805 | 0.433 | | 4.817 | 0.406 | | 4.805 | 0.607 | | 4.805 | 0.433 | |
| 4 | 4.558 | 0.518 | | 4.579 | 0.476 | | 4.558 | 0.726 | | 4.558 | 0.518 | |
| 5 | 4.307 | 0.624 | | 4.339 | 0.569 | | 4.307 | 0.873 | | 4.307 | 0.624 | |
| 6 | 3.983 | 0.922 | | 4.032 | 0.841 | | 3.983 | 1.291 | | 3.259 | 0.922 | |
| 7 | 3.676 | 0.897 | | 3.742 | 0.812 | | 3.676 | 1.255 | | 3.008 | 0.897 | |
| 8 | 3.447 | 0.554 | | 3.532 | 0.464 | | 3.447 | 0.776 | | 2.821 | 0.554 | |
| 9 | 3.229 | 0.538 | | 3.332 | 0.444 | | 3.229 | 0.753 | | 2.642 | 0.538 | |
| 10 | 3.020 | 0.522 | 54.915 | 3.141 | 0.425 | 57.116 | 3.020 | 0.731 | 54.915 | 2.471 | 0.522 | 54.915 |
| BPC | 41.332 | 5.440 | 54.915 | 41.828 | 4.841 | 57.116 | 41.332 | 7.616 | 54.915 | 38.176 | 5.440 | 54.915 |
| BOND PRICE | | | 101.687 | | | 103.785 | | | 103.863 | | | 98.531 |

**Case table 43.3** Pricing Morocco 10y EVB at different recovery values/ratings, and as SLBD

We reprice the structure with a 1% step-down after 5yrs, which clearly is of lower value to investors => **98.531.** However, if we add contingent enhanced recovery (from 25% to 48%), the price of the bond jumps up to the EVB level again → **101.690.**

**Due to the perception of risk being backloaded, providing credit enhancement in the back end allows for a very substantial step-down structure.**

| YEAR | SLBD, -1.0%SD, NCR25% DISC COUPON | EXP RECOVERY | NOMINAL | SLBD, -1.0%SD, CR48% DISC COUPON | EXP RECOVERY | NOMINAL |
|---|---|---|---|---|---|---|
| 1 | 5.26 | 0.140 | | 5.262 | 0.140 | |
| 2 | 5.04 | 0.292 | | 5.043 | 0.292 | |
| 3 | 4.80 | 0.433 | | 4.805 | 0.433 | |
| 4 | 4.56 | 0.518 | | 4.558 | 0.518 | |
| 5 | 4.31 | 0.624 | | 4.307 | 0.624 | |
| 6 | 3.26 | 0.922 | | 3.259 | 1.770 | |
| 7 | 3.01 | 0.897 | | 3.008 | 1.721 | |
| 8 | 2.82 | 0.554 | | 2.821 | 1.064 | |
| 9 | 2.64 | 0.538 | | 2.642 | 1.033 | |
| 10 | 2.47 | 0.522 | 54.915 | 2.471 | 1.003 | 54.915 |
| BPC | 38.176 | 5.440 | 54.915 | 38.176 | 8.598 | 54.915 |
| BOND PRICE | | | 98.531 | | | 101.690 |

**Case table 43.4** (left) SLBD structures without contingent recovery; (right) with contingent recovery to make the SLBD same value as the EVB

Assume that all the incentives and the (concessionary) credit enhancement allows us to uprate the whole structure from BB+ to BBB-: → **103.30.** We can give back some of that value increase to the issuer as an incentive (split 50/50 on assumption of rating upgrade) in the form of the step-down going from -1% to -1.25% → **102.492.**

Going back to the start, the EVB should price at 101.687. **If the investor has assurances or strong belief that a one-notch upgrade is justified based on increased resilience, the SLBD structure would be bought at any level below 102.492, and this structure would provide a material incentive for the issuer to execute on the resilience targets.**

| YEAR | SLBD BBB-, -1.0%SD, NCR48% DISC COUPON | EXP RECOVERY | NOMINAL | SLBD BBB-, -1.25%SD, CR48% DISC COUPON | EXP RECOVERY | NOMINAL |
|---|---|---|---|---|---|---|
| 1 | 5.264 | 0.131 | | 5.264 | 0.131 | |
| 2 | 5.049 | 0.273 | | 5.049 | 0.273 | |
| 3 | 4.817 | 0.406 | | 4.817 | 0.406 | |
| 4 | 4.579 | 0.476 | | 4.579 | 0.476 | |
| 5 | 4.339 | 0.569 | | 4.339 | 0.569 | |
| 6 | 3.299 | 1.615 | | 3.116 | 1.615 | |
| 7 | 3.062 | 1.560 | | 2.892 | 1.560 | |
| 8 | 2.890 | 0.890 | | 2.729 | 0.890 | |
| 9 | 2.726 | 0.852 | | 2.574 | 0.852 | |
| 10 | 2.570 | 0.816 | 57.116 | 2.427 | 0.816 | 57.116 |
| BPC | 38.595 | 7.588 | 57.116 | 37.787 | 7.588 | 57.116 |
| BOND PRICE | | | 103.300 | | | 102.492 |

**Case table 43.5** (left) SLBD structures without contingent recovery; (right) with contingent recovery to make the SLBD same value as the EVB

## 6.4 CALLABILITY: A LOOPHOLE OR A CHIMERA?[31]

A main critique of SLBs, as highlighted in Chapter 1, concerns callability. It is sometimes suggested that bond issuers are pushing calls into bond structures to wriggle out of sustainability commitments. For example, a recent policy paper states, *"SLB [...] call options are designed to potentially minimize penalties."*[32]

This section focuses on the callability aspects of SLBs and conducts a comprehensive study of their relationship with other key aspects of the structure, such as the KPI observation period, step-up dates, and maturity dates, in order to assess the validity of these concerns.

Debt raised via bonds or loans in the capital markets often include certain covenants. These serve to define the rights of debt holders and minimise agency costs with management and shareholders. Restrictive covenants can be substantial in high-yield bonds relative to investment-grade bonds. As high-yield issuers have more credit risk, bondholders typically demand stronger protection through more restrictive covenants. These can include restrictions on further leverage, limitations on asset sales, change of control protections, early redemptions, and make-whole provisions.[33]

As argued in Chapter 3, from a game theory perspective, issuers who place debt less frequently (such as high-yield issuers) have to accept covenants from investors, as the cost to them of breaching repayment commitments may be too small otherwise.

This section will analyse bond call options, also know as early redemptions. These are common in the bond market. They afford the issuer the right, but not the obligation, to buy back the bond on a pre-determined date at a pre-determined price or spread.

To respond to the criticism that SLBs are often structured with calls so that their issuers can avoid paying a step-up coupon, we address the following three research questions:

- Are there more callable bonds among SLBs, and what is the composition of such bonds?
- Is there a systematic difference in calls when we compare SLBs with non-SLBs?
- How are the call dates for SLBs related to KPI observation and step-up dates?

Next, we describe the data collection method and look to address these questions with different visualisations and by quantifying the differences where possible. The final section offers conclusions and advice for further research.

### 6.4.1 CALLABILITY STRUCTURES IN THE BOND MARKET

Callability comes in several different shapes and sizes, and before looking specifically at SLB callability, it can be useful to understand the principal forms:

- **Hybrid bonds:** As discussed in the first section of this chapter, hybrids are commonplace in the Utilities sector[34] and in other sectors where AT1s [Alternative Tier One] feature. They are a way for corporates to issue subordinated capital. A common structure will be "Perp-nc-5", i.e., a perpetual bond but with a call after five years. Traditionally, the majority of these calls are executed, and thus the hybrids are priced to the first call date rather than to perpetuity.
- **Bank capital:** Following a number of liquidity crises over the past two decades, regulators have favoured giving banks greater flexibility to repay senior bonds. This has led to a large proportion of "11nc10" structures (reads "eleven-non-call-ten"). For practical purposes,

[31] This analysis was originally published as "SLBs: no cal(l)amity", AFII, 20 Sep 2023.

[32] "Structural Loopholes in Sustainability-Linked Bonds", Ul Haq and Doumbia, World Bank Policy Working Paper Series, 2022; A similar view is expressed in "The Design Flaw in Sustainability-Linked Bonds", Lefournier, J., Chaire Énergie et Prospérité Working Paper, Jun 2023.

[33] For an extensive discussion on the various shapes and forms of covenants, see Bernd Bohr, "High Yield Bonds An Issuer's Guide", Mayer Brown, 2020.

[34] They are also common in the Telecoms sector, see "On the Pricing of Step-Up Bonds in the European Telecom Sector", Lando and Mortensen, SSRN, 2004.

investors will view these as 10yr bonds but with the understanding that the bank could extend by up to one year if in need of liquidity. Variations on this call structure are available down the capital structure.

- **General liquidity calls:** Over the last decade, there has been a trend – emanating from the US – to set calls shortly before the maturity date of vanilla bonds, e.g., one- or three-month par calls. We understand this is a liquidity management play by companies. Often a bond will have been refinanced 6-12 months prior to maturity, and one can argue that the issuer is then paying 'excess interest' if they are not able to place their excess liquidity at the same rates they are paying on their bonds. Having an option to call the maturing bond a bit earlier is simply economical.[35] These types of calls are often referred to as "clean-up calls" and are set very close to the bond maturity.

- **High-yield and crossover calls:** Issuers with wider spreads, often private equity-owned companies, will issue callable bonds where the calls are substantially inside the maturity date of the bonds. They have a structured call price, typically paying par plus half the coupon after half the term and decreasing the premium by half, yearly, until par or maturity. They also have 10% calls where the issuer can call 10% of the outstanding in a year. These allow issuers to refinance at more attractive rates if the underlying (high-risk) company has improved their creditworthiness. From this perspective, the economic incentives to call high-yield or crossover bonds may be substantial, if the desired-for improvement in credit spreads occurs.

Most bonds also have make-whole provisions. Unlike a call option with a fixed price, these are set at a spread over a benchmark bond, typically the closest government bond. These provisions allow issuers to retire their debt provided they compensate the investors. The provision lasts until the bond's call date. This is even more costly than a regular call as the issuer redemption spread is tight to where the market spread would be and, if it is lower than par, the investor needs to be paid back at par. Studies show make-whole provisions get exercised often despite the high financial costs.[36]

When it comes to SLBs, the make-whole provision provides an additional option to the issuer, as the bond could be made-whole ahead of any thematic default (i.e., failure to achieve an SPT). As discussed in Chapter 4, the market is starting to experience a few of these thematic defaults but with no make-whole calls prior to such events, to our knowledge.
A simple reason for this is that it is expensive for an issuer to exercise a make-whole provision, much more so than paying a coupon step-up.[37] To understand the typical costs involved, we show a working example in case study 44.

The following study seeks to understand if issuer motivations are equally distributed between SLB and non-SLB issuances, or if the SLB markets have a different distribution of calls and placement.

### 6.4.2 CREATING AN APPLES-FOR-APPLES SLB VS NON-SLB SAMPLE

Given the volatile conditions of the bond market since the inaugural SLB was issued in 2019, there is a relatively small universe of comparable SLB and non-SLB issuances. Furthermore, patterns of SLB and non-SLB issuance have varied over this short time frame.[38]

Therefore, we elected to identify comparable vanilla bonds for selected SLBs in order to explore callability differentials. This allows us to ask questions like: "given this particular SLB, if we have similarly rated bonds, from the

[35] See, for example, "Three month par calls: a useful tool for senior issuance", GlobalCapital, May 2021.

[36] "The Life Cycle of Make-Whole Call Provisions", Scott Brown and Eric Powers, Journal of Corporate Finance, Dec 2020.

[37] "SLB Triggers: What next If Nobian or PPC Miss Their Targets?", AFII, Feb 2023.

[38] "SLBs: complementary my dear Investor", AFII, Apr 2023, contains a broader discussion on the issuance patterns in SLBs. The study concludes among other things that SLBs are more frequently used in harder-to-transition industries, among lower-rated entities and in Lat Am emerging markets.

same sector, issued at roughly the same time, can we identify any differences in callability structures?"

We collected data on all active SLB issues from January 2019 to June 2023, for a total universe of 846 bonds. Next, we identified a comparable non-SLB universe, using the Bloomberg COMB function, which identifies peer bonds based on duration, industry classification, and other characteristics.

The COMB algorithm identifies peers across industry and issuer categories. For industry peers, it selects from specific to general industry-level matches, until a satisfactory number of peers is found. Depending on the issuer size, rating, and duration of the particular bond, it could identify between two to more than 20 bonds. To avoid selection bias, we randomly select a maximum of five peers in each industry and issuer group.[39] This resulted in 4,200 bonds in total.

As these were all related bonds, we removed the duplicates and filtered for non-SLB bonds. This reduced the comparable universe to 3,219.

We then excluded non-rated issuers from both SLB and non-SLB universes, as we found the data for these to be inconsistent.[40] We filtered out any Government and Financials as bonds issued by these sectors exhibit different characteristics than the broad corporate market we elected to focus on.[41]

We then applied two further filters. First, only EUR and USD issues are considered, as these are the largest debt markets and as such have better transparency in terms of observability and call dates. This is currency rather than issuer specific: we include all international issuers who raise debt in these two currencies. We use this set to report the issuance and call analysis by vintage.

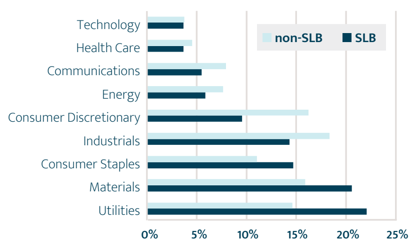
Second, we limit the initial outstanding amount to greater than USD300mn in either of these currencies, as these are bonds that could be traded in meaningful lots and for which the price histories are more reliable.

This data processing results in a final universe of 1,368 bonds, of which 272 are SLBs and the rest are non-SLBs. The number of bonds by type and currency and rating is shown in Table 6.7. SLBs are less common at single A or above credit ratings compared to non-SLBs. Figure 6.5 shows the industry composition. The size of the markets is also very different; SLBs are a small part of the larger bond market. We avoid

**Table 6.7** Count of SLBs and non-SLBs issued (% of category issuance by amount) by rating in the benchmark sample. Last row showing total count of bonds (amount issued) in the category

| RATING | NON-SLB EUR | USD | SLB EUR | USD |
|---|---|---|---|---|
| AA | 32 (7%) | 8 (2%) | 3 (4%) | 0 (0%) |
| A | 169 (28%) | 62 (14%) | 15 (12%) | 11 (9%) |
| BBB | 260 (40%) | 155 (34%) | 71 (53%) | 63 (52%) |
| BB | 106 (14%) | 138 (36%) | 23 (17%) | 39 (27%) |
| B | 88 (11%) | 58 (12%) | 20 (11%) | 19 (11%) |
| CCC AND BELOW | 5 (1%) | 15 (3%) | 6 (3%) | 2 (2%) |
| TOTAL | 660 (445) | 436 (356) | 138 (92) | 134 (105) |

**Figure 6.5** Industry composition of SLBs and non-SLBs

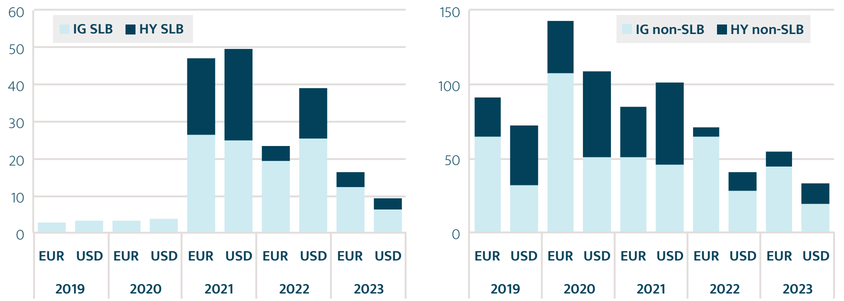



[39] For SLBs with fewer than five peer bonds, we use all peers. Where there are more than five comparables, we use the random.sample function in Python to select five.

[40] This had a bigger impact on the SLB universe, as 98% of such SLB bonds were not callable and they represented 35% of the amount outstanding according to Bloomberg.

[41] In Financials, 18 SLBs were removed. The COMB algorithm also identifies peers from wider industry, especially Financials, if it doesn't find enough matching peers for a given bond. For the unrated SLBs, it generated mostly Financials (501 bonds), which are filtered out. Five Government bond peers were found, which are also out of the sample. Government bonds have different credit criteria and deal sizes which would skew the study. We did a test including these, and the results were even stronger, with reduced callability in SLBs.

**Figure 6.6** SLB and non-SLB issuance in billions by credit grade




filtering bonds by credit risk criteria such as ratings or sector levels as this would potentially bias the dataset and provide subset rather than general conclusions. Instead, we test the statistical significance of such differences given the discrete characteristics of SLB and non-SLB universes.

We need to look at market conditions to understand callability, not just this feature in isolation. Issuance volumes – and hypothetical issuance patterns – change over time and across bond vintages. The varying nature of interest rates from 2021 to 2022-23 will have impacted issuer decisions on including callability, regardless of sustainability criteria. If markets are weak (with high rates and lower equity valuations), issuer-friendly protections like callability could be impacted. Figure 6.6 shows the total benchmark (defined as over USD300mn size) issuance from SLBs on the left and non-SLBs on the right from 2019 to June 2023. Labels show year-on-year changes for each category and currency.

### 6.4.3 CALLABILITY CONSIDERING SLB VINTAGES AND CREDIT RATINGS

Out of the 1,368 bonds in our final universe, 93% of SLBs and 87% of non-SLBs are callable. We analyse this callability over different vintages, credit grades, and distribution to shed light on any systematic differences.

As one might expect, total bond market issuance varies between bull and bear market years. We are interested to see whether there is a difference in the proportion of callable bonds issued over time and how SLBs and non-SLBs compare.

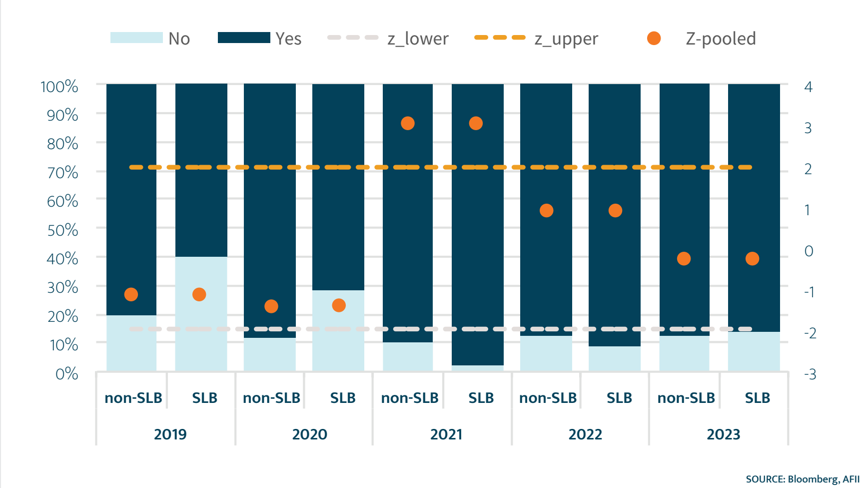
Figure 6.7 shows the proportion of callable versus non-callable bonds issued across 2019-2023 vintages. The clear takeaway is yes, there is a high proportion of SLBs with callability, but this is also the case for other bonds and markets. In 2023, over 86% of all bonds in the sample have some form of callability. We believe this is an important point, as SLB observers may not have been aware of how prevalent callability has become throughout the bond market.[42]

Another key point is that **callability patterns in SLBs and non-SLBs only differ in 2021.** We use a pooled z-score test statistic to understand the differences in the proportion of callability.[43] A z-score represents how much a sample's value is different from the group value – in this case, the number of callable SLBs versus callable non-SLBs. It is measured as the number of standard errors the value is away from the group value – here, the proportion of bonds that are callable. A z-score of 0 would mean that the SLBs score the same as the group mean value.

[42] For a wider discussion of call options in bond markets please see "Kicking Maturity Down the Road: Early Refinancing and Maturity Management in the Corporate Bond Market", Xu, Qiping, The Review of Financial Studies, Aug 2018.

[43] See "Introductory Statistics", Barbara Illowsky and Susan Dean, 2018.

**Figure 6.7** SLB and non-SLB callability per vintage, 2019-2023 YTD. Based on AFII SLB and non-SLB comparable universe




SOURCE: Bloomberg, AFII

Figure 6.7 shows the lower and upper range of the test scores. 2021 is the outlier, when the SLB market had 98% of bonds that were callable, compared with 90% for non-SLBs, for a z-score of 3.06. Looking at more recent years, 2022-23, this difference is lowered and even turned around for YTD 2023 issuance. This is reflected in z-scores of closer to 0.

If we look to the early SLB years of 2019-20, these structures were less likely to be callable relative to non-SLBs. This is intuitive: as the market was developing, bonds were structured to have as few extra features as possible, with the focus being on the step structures themselves. As the SLB market has matured, it has started to converge with standard bond structures.

In conclusion, in 2021 we see evidence of increased callability for SLBs, but no statistical difference for other vintages.

Next, we compare SLBs and non-SLBs callability by credit grades. Figure 6.8 shows the proportion of bonds issued along the credit risk dimension in the broad Investment-Grade (IG) and High-Yield (HY) categories. In HY markets, SLB and non-SLB callability patterns are similar, with over 97% of the bonds having a call option. As noted earlier, this is a feature of the HY market as issuers are generally smaller than their IG peers and would want the flexibility to call debt if the market improves or any M&A situation occurs.

In the IG market, we see a marked difference with 89.6% of SLBs having calls compared to 81% of non-SLBs. This could lend support to the view that SLBs are more likely to be callable than non-SLBs, at least in the IG universe.

Figure 6.9 shows a further breakdown of the IG universe from the highest AA grade down to BBB, which further corroborates that **as ratings go down, callability goes up in similar proportions between SLBs and vanilla bonds.**

### 6.4.4 CALL DATES: HOW FAR AHEAD OF ULTIMATE MATURITIES

In this section, we seek to answer two questions. First, are call date placements systematically different for SLBs compared to non-SLBs? Second, specifically for SLBs, what are the relationships between call dates, step-up dates, and KPI observation dates?

**Figure 6.8** Callability by credit grade of SLBs and non-SLBs

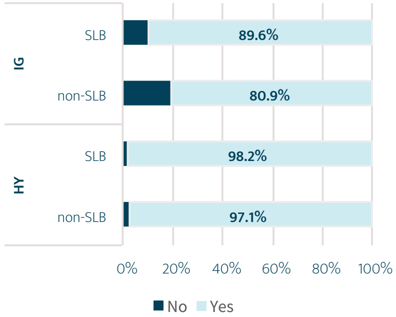
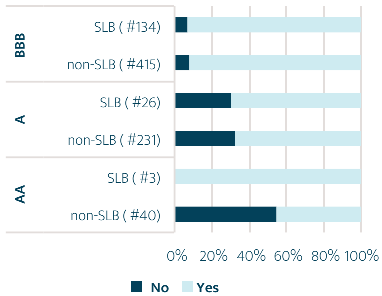



**Figure 6.9** Callability: IG credit drill down for SLBs and non-SLBs




To answer the first question, we define a new variable, the call-to-maturity ratio. It is the ratio between the period from the issue date of a bond to its first call date and maturity, as shown in Figure 6.10.

For non-callable bonds, we define this value as 1 and exclude them from the analysis. We also exclude maturities with less than one year and more than 30 years (mostly perpetual bonds which have no fixed maturity).[44] This results in a sample of 909 non-SLBs and 249 SLBs.

Figure 6.11 plots the cumulative distribution of SLBs and non-SLBs call-to-maturity ratio. It shows that 34% of SLBs have a call date at less than half of their maturity. We see over 60% of bonds have calls that are close to maturity, which as we discussed earlier, are commonly used to manage liquidity. Visually, the distributions look similar with SLBs having more short-dated calls. To determine whether this is statistically significant, we use the Kolmogorov-Smirnov (KS) test to see if both the SLBs and non-SLBs are from the same distribution.[45]

The results are shown in Table 6.8. The maximum difference was 8.3% at the call-maturity ratio of 0.971, the "liquidity call" end. The null hypothesis that they are from the same distribution cannot be rejected at a 5% threshold level as the reported p-value is 0.127. The result shows no systematic difference between the placement of call dates for SLBs and non-SLBs. However, this could change with different data settings as there is a weak case for an alternative if we relax our threshold levels from the normal 0.05 level.[46] **Therefore, our conclusion is that call dates relative to bond maturities are not materially different between SLBs and non-SLBs.**

**Table 6.8** Testing if SLB and non-SLB call date distributions are similar

| RESULTS | VALUE |
|---|---|
| KS STATISTIC | 0.083 |
| P-VALUE | 0.127 |
| STATISTIC-LOCATION | 0.976 |
| STATISTIC-SIGN | -1 |

[44] Over 30 years is a very long period to price call options. We also need to have fixed maturity date for this analysis so had to remove Perps that don't have a fixed maturity.

[45] "Kolmogorov–Smirnov Test: Overview", Vance W. Berger and YanYan Zhou, John Wiley & Sons Ltd, 2014.

[46] We performed the same KS test, without the clean-up calls, by filtering out bonds with a call-to-maturity ratio greater than 0.89. This removed 60% of the sample. The p-value was even higher at 0.227, with the KS statistic at 12% and the location at 0.43 call-to-maturity ratio. This supports earlier results on the larger sample.

**Figure 6.10** Call-to-maturity ratio of a bond

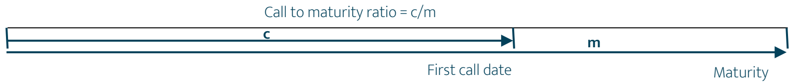
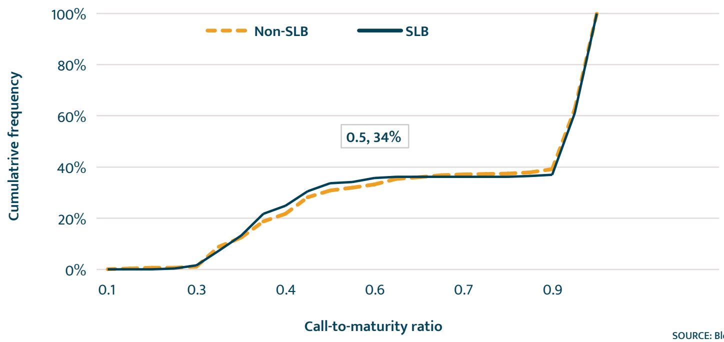



**Figure 6.11** SLB and non-SLB call dates as a fraction of the total maturity. A high number/fraction indicates a call date close to the maturity date




SOURCE: Bloomberg, AFII

On to the second question. Concerns with SLB callability are focused on those instruments with call dates prior to actual coupon step dates. So far, systematic data on step-up dates is only available in bespoke datasets. In Figure 6.12, we review call dates versus KPI observation dates on several SLBs in the AFII database.[47]

The scatter plot has the x-axis from the issue date to the first call date and the Y-axis from the issue date to the first KPI observation date. We filter out observation dates in the next year.

We find a strong linear relationship, showing call dates are much later than the KPI observation or step-up dates. The blue dotted line shows this relationship, with a goodness-of-fit measure of 0.971. The grey dotted line shows a similar relation to the actual step-up dates and call dates. The step-ups that precede callability are only slightly closer to call dates than observation dates. This is expected as the step-up dates have to be after the KPI observation dates.

**Given call dates are usually after the step-up dates, it is hard to argue they are used by issuers to evade their sustainability performance tests.[48]**

### 6.4.5 CALLING BONDS IN A HIGH(ER) INTEREST RATE MARKET

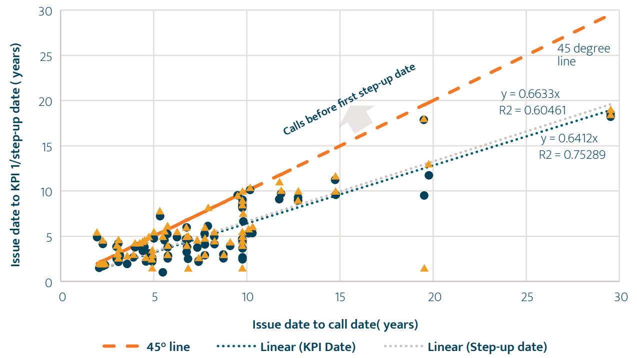
Market price plays a significant role in the valuation of call options. The interaction between the default risk of a bond with call options and stochastic interest rates is well studied.[49] In a rising rate environment, it is highly unlikely that bonds issued in a market where rates were lower will be called, all else being equal. A significant event, such as an M&A situation, could make for an exception.

[47] This is a bespoke database of SLBs populated with more granular information on KPIs and other terms of SLBs. It currently covers over 400 SLBs in general, and 100+ in terms of the most specific data and analysis. Applying other filters reported earlier, this sample is of 80 bonds. We believe this is a representative – if small – sample and will return to this analysis as the database gets further populated. SLB documentation is not always straightforward in terms of providing exact SPT and observation date information.

[48] A call date prior to the sustainability performance test date would imply that the issuer could almost fully disregard the sustainability targets, whereas calls after the SPT test date would incur both economic costs (higher coupon payments) as well as the reputational cost of having failed a target, making the targets still relevant. These two cases are represented by the sets above/below the 45 degree line in the Figure.

[49] "Corporate Bond Valuation and Hedging with Stochastic Interest Rates and Endogenous Bankruptcy", Viral V. Acharya and Jennifer N. Carpenter, The Review of Financial Studies, Oct 2002.

**Figure 6.12** Call-to-KPI observation date, step-up dates



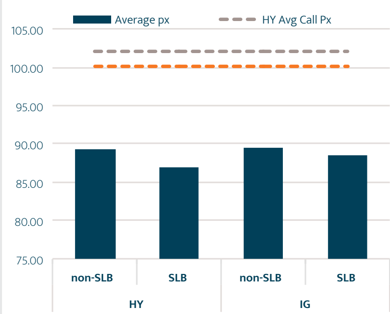

SOURCE: AFII

To further understand the likelihood of a call being exercised, Figure 6.13 shows the average trading price of SLBs and non-SLBs. The grey dashed lines denote average call price for HY (price of 102) and IG bonds (price of 100). We note the higher premium in the calls embedded in HY bonds, which is structurally driven due to the call schedules. The averages may be an imprecise measure but still give a good indication of where the markets stand. Call prices are fixed, so we compare the current prices to the call.

The HY SLBs are trading between 85 to 90. If an average SLB bond trading at 87 is called at 102, this represents a 15% cost. When 50bps is considered material in the market (a typical step-up is 25bps and a period of five years of step-ups represents 2.5% cost without discounting), a 15% cost seems unlikely to be acceptable. It will be a significant cost to any issuer, especially one with limited flexibility to call bonds in the intermediate term, unless interest rates move down drastically. We can safely speculate that, on average, few call options will be exercised. Specifically, with SLBs, the cost of step-ups on a bond price basis is only a fraction of that for exercising the call option, which will be signficant in the current high interest rate environment.

In the event that SLBs are structured with more material step-ups, and a rate rally moves calls closer to At-The-Money (ATM), it is possible that calls could be exercised more frequently among SLBs than non-SLBs. Clearly, to repeat the message of Figure 6.13, we are far away from this scenario at the moment,[50] and would expect investors to adjust their pricing views and models accordingly.[51]

**Figure 6.13** Market price of SLBs and non-SLBs vs. average call price levels




SOURCE: Bloomberg, AFII

[50] A recent discussion around the non-attractiveness of calling bonds in this market can be found in “Companies Face Hybrid Bond Dilemma: Refinance or Ditch the Debt”, Bloomberg, 30 Aug 2023, discussing how expensive it is for hybrid bond issuers to call bonds at the first date, making some issuers considering alternatives in the face of well-cemented investor expectations (of calls to happen).

[51] For example, many investors use option-adjusted spread (OAS) spread metrics rather than z-spreads to price bonds in spread terms when there are embedded options in the structures. A future research area would be to implement an OAS pricing model for SLBs..

## CONCLUSIONS

In this section, we have conducted several analyses seeking to establish if there is "excess" callability in SLBs compared to traditional bonds. At the core of these quantitative investigations has been a dataset generated using a third-party algorithm for selecting comparable traditional bonds to the individual SLBs.

We compare this sampled dataset across a few dimensions:

- **Year issued (vintage):** Comparing older bonds with newer bonds could create biases, if there is time variation in callability – as we argue there is. When we compare SLB versus non-SLB callability across different years, we only find a significantly higher callability for SLBs in 2021.
- **Credit quality/rating:** Callability traditionally varies depending upon credit quality, and earlier studies have shown SLBs to be a preferred issuance form for higher-yielding credits than, for example, green bonds. Our results reflect this: we find substantially higher callability ratios for HY bonds, but no difference in callability between SLBs and non-SLBs once we have normalised for rating.
- **Call date timing:** The main critique against SLB callability has been if calls are prior to SPT observation dates. We find very few instances where this happens in our dataset, and on an aggregate level, SLB call dates seem to have a time-before-maturity distribution very similar to that of traditional bonds.

Furthermore, we discuss the economics of calling bonds, and argue that the financial incentive to call an SLB (in terms of coupon step-up avoidance), is not compelling in a high interest rate environment.

**This leads us to suggest that callability in SLBs may be an idiosyncratic issue and a valid critique of some specific issuances, but should not be seen as a major flaw in the structure per se. Indeed, this analysis strengthens our conviction that fixed income investors would not be buying structures with 'loopholes' to their economic detriment.**

# CASE STUDY 44
## CALLABILITY AND MAKE-WHOLE CLAUSES: GLENCORE

**RESEARCH: SLBS: NO CAL(L)AMITY), SEP 2023**

**BOND: GLENLN EUR0.75% 03/29 (XS2307764238)**

We present a Glencore bond issued in 2021 with some callability features.

- "Make-whole @ 20"
- "Call 12/01/28@100" is a call one year ahead of the maturity date.

The make-whole provision in the prospectus and the final terms are in Case figure 44.1; the calculation is shown afterwards.


**Case figure 44.1** Screenshot of DES for GLENLN EUR0.75 03/29 bond (ISIN XS2307764238). Source: Bloomberg

Case table 44.2 provides the make-whole calculation. The current column uses the most recent spread. For the make-whole price, the input spread is 20bps. The make-whole can be done before 01/12/2028, so we have a work-out date one day before that and it can be called after that at a fixed price of 100, which is shown in the last column. Using the years remaining from now to the workout day, we calculate the net present value (NPV) of the coupon and the price, which is 89.60 for make-whole. This price turns out to be lower than par, and as per the provisions shown in Case figure 44.1, it should be the higher price or the principal amount, which is a face value of 100. The final price will also include accrued interest until the settlement date

| | |
|---|---|
| BOND | GLENLN EUR0.75 01/29 |
| ISIN | XS2307764238 |
| FACE VALUE | 100 |
| COUPON | 0.75% |
| REFERENCE BOND | DBR 0.2% 02/29 |
| YIELD OF REF BOND | 2.66% |
| CALC DATE | 12/07/2023 |

| | CURRENT | MAKE-WHOLE | CALL |
|---|---|---|---|
| INPUT SPREAD | 2.0% | 0.2% | |
| WORKOUT DATE | 01/03/2029 | 20/11/2028 | 01/12/2028 |
| PERIOD (YRS) | 5.64 | 5.39 | 5.39 |
| COUPON NPV | 3.64 | 3.70 | |
| PRICE | 81.00 | 89.60 | 100.00 |
| MAKE-WHOLE PRICE | | 100.00 | |

**Case table 44.2** Make-whole calculations for the Glencore bond

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