

# JBS: A meaty SLB impact proposal

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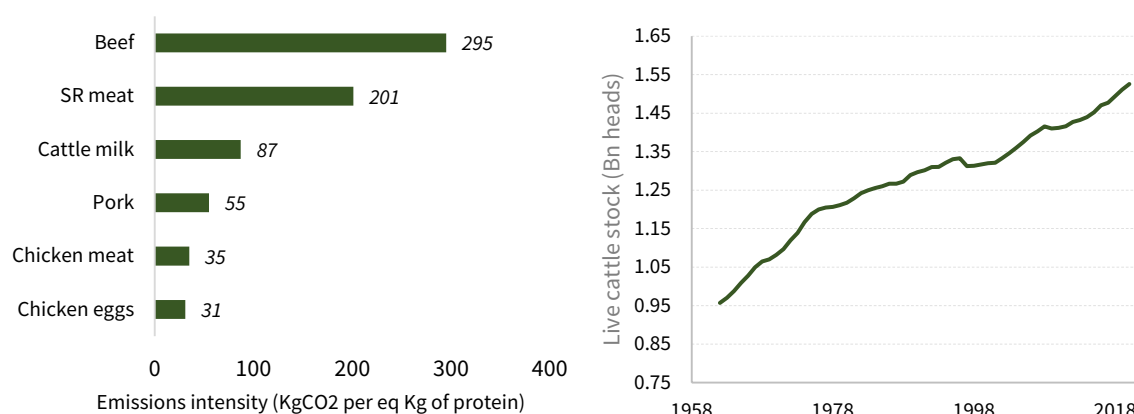
**Meat processing has a major role to play in tackling climate change and, as the world's largest meat producer, Brazilian company JBS' sustainability-linked bonds (SLBs) present an opportunity to lead the sector in delivering positive sustainability impacts.**

JBS issued two SLBs in 2021 which were successfully placed in the market but criticised for addressing only a small proportion of the company's emissions and failing to include deforestation targets.

**This paper argues that an increase in the ambition of future SLB issuances would benefit both JBS and its investors. Using our options pricing approach, we demonstrate how a 25 basis points (bps) lower cost-of-capital could be achieved.**

World cattle stock has grown by 62% over the past 60 years to feed global demand, with beef in particular being an inefficient source of protein (see Figure 1). Latest research suggests that **global livestock accounts for 16.5% of all anthropogenic GHG emissions**,<sup>1</sup> including methane produced by cows' digestive processes. Converting land for grazing purposes generates deforestation thereby destroying natural carbon sinks. It is generally acknowledged that meat production is a climate change mitigation priority.

Figure 1. Emissions by source of protein (left) and growth of world cattle stock (right). Source: [FAO](#), [AFII](#)



<sup>1</sup> [“Emissions from Animal Agriculture—16.5% Is the New Minimum Figure”](#), Twine, R., Sustainability 2021, 13(11).

## JBS: SLB limitations and potential solutions

As one of the world's biggest producers of beef, JBS has achieved impressive historical growth. This has of course led to an inexorable rise in its carbon emissions. The Institute for Agriculture and Trade Policy (IATP) states that JBS saw emissions<sup>2</sup> rise by 51% since 2016,<sup>3</sup> a major increase even within an emissions-intensive sector.<sup>4</sup>

In this context, JBS' decision to issue two SLBs<sup>5</sup> with performance targets tied to delivering reductions in carbon emissions<sup>6</sup> was welcomed by the market.

Yet it also received criticism<sup>7</sup> for the low sustainability impact of the structures. The Key Performance Indicators (KPIs) did not include "Scope 3" emissions,<sup>8</sup> which in fact represent most of JBS' overall emissions. Nor was Brazilian deforestation included in its targets. Furthermore, insignificant financial penalties were set, if JBS fails to meet its goals. Detailed analysis of JBS emissions and its latest bond curve is included in Annex A.

This paper conducts an analysis on the issuer, considering how to improve its current SLB structure. We assess what a structure would look like that takes a more holistic perspective on the company's activities.

We propose that carbon emission reductions should be driven through the whole value chain beyond "Scope 1 and 2" emissions,<sup>9</sup> in line with ICMA's recently released KPIs registry for the Food and Agricultural sector.<sup>10</sup> Second, given the business of JBS, especially in rainforest areas, we propose a KPI on deforestation.

We assess how this should be priced in an options-pricing context, building on a pricing framework for SLBs that AFII developed ([An option pricing approach for sustainability-linked bonds](#), AFII Discussion Paper, Mar 2022).

For purposes of this paper, it should be noted that the option pricing approach does derive a theoretical value of the optionality in an SLB, which could be translated into what the market commonly refers to as a "greenium". However the option premium is different in that investors are not at a loss to the benefit of the issuer but rather a direct exchange of risk between two parties. We refer to the appendix in our SLB option pricing paper that looks at an example of an SLB's spread differential to a regular bond into three main components: option premium, "greenium" (non-pecuniary driven demand for the bond) as well as the new issue-premium.

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<sup>2</sup> Including Scope 3 emissions.

<sup>3</sup> "[World's largest meat company, JBS, increases emissions by 51% in five years despite 2040 net zero climate target, continues to greenwash its huge climate footprint](#)", IATP, 21 Apr 2022.

<sup>4</sup> "[According to ISS ESG data, JBS ranks 17th out of 46 companies in the Food & Beverages Industry in terms of GHG emissions intensity](#)", ISS ESG, 8 Jun 2021.

<sup>5</sup> One through its USA subsidiary, JBS USA JBSSBZ 3 05/15/32 Corp; ISIN US46590XAD84 and one through Luxembourg entity, JBSSBZ 3 5% 01/15/32 Corp; ISIN USL5S59NAA30.

<sup>6</sup> "[JBS USA Announces Successful Issuance of Sustainability-Linked Bond](#)", JBS home page, 16 Nov 2021.

<sup>7</sup> "[JBS shows SLB label is nothing without scrutiny](#)", Global Capital, 15 Jun 2021.

<sup>8</sup> For a definition, see "[Briefing: What are Scope 3 emissions?](#)", Carbon Trust website, accessed 16 Aug 2022.

<sup>9</sup> Ibid.

<sup>10</sup> "[Sustainability-Linked-Bonds Principles – Illustrative KPIs registry](#)", ICMA, June 2022.

## Emissions: Adding Scope 3 into the SPTs

Both SLBs issued last year selected KPIs based on Scope 1 and 2 emission intensity. Whilst JBS reports Scope 3 emissions to around 10% of its total emissions, both ISS and CDP estimate JBS' Scope 3 emissions to represent the vast majority of the company's total emissions. The Science Based Targets initiative (SBTi) recommends that where over 40% of emissions are from Scope 3, a Scope 3 target is required.<sup>11</sup>

While we recognize there are difficulties for meat processing companies to evaluate their Scope 3 emissions due to complex supply chains and lack of widely accepted measurement methodology in the industry, one can argue – and we would be supportive of such a view – that exclusion of Scope 3 means that the potential impact of the bonds is only marginal.<sup>12</sup>

In order to set a reasonable Scope 3 target for JBS, we have applied CDP/WWF's methodology<sup>13</sup> to estimate what reduction would be consistent with a 1.5 degree warming goal. Based on that analysis, we suggest a targeted reduction of -24% of their Scope 1, 2 and 3 emissions by 2026.<sup>14</sup> This is more ambitious than the original KPI of -30%, as it applies over six years rather than the original 11 years. The implication of this would be a reduction by 2026 in emissions of around 6Mtpa CO<sub>2</sub>e, or equivalently of 21% in the new SLB structure versus the old ones.

Table 1. KPIs in current and proposed structure. Source: JBS, AFII.

	Current SLBs	Proposed KPI
<b>KPI</b>	Greenhouse gas (GHG) emission intensity (Scope 1 and 2, in MtCO <sub>2</sub> per MT of product)	Absolute Scope 1, 2 & 3 emissions (MtCO <sub>2</sub> )
<b>Baseline</b>	2019	2020
<b>SPT</b>	-30%	-24%
<b>End Observation</b>	2030	2026

Figure 2. Difference in the original CO<sub>2</sub> related KPIs vs AFII's proposal. Source: JBS, CDP, AFII.

Original KPI	Scope 1	Scope 2	Scope 3	TOTAL	Proposed KPI	Scope 1	Scope 2	Scope 3	TOTAL
2019 baseline	4,594	1,616	40,019	46,228	2020 baseline	4,650	1,554	25,306	31,511
Implied reduction by 2026	-19%	-19%	n/a		Target reduction by 2026	-24%	-24%	-24%	
2026 emissions	3,717	1,307	25,306	30,330	2026 emissions	3,534	1,181	19,233	23,948

-21%

<sup>11</sup> “[SBTi Corporate Net-Zero Standard Criteria](#)”, Science Based Targets, 28 Oct 2021.

<sup>12</sup> “[SLB bond radar: Eni \(potentially\) coming to market](#)”, AFII, 19 Jul 2022, argues for Scope 3 inclusion in another hard-to-abate sector, oil production.

<sup>13</sup> “[CDP-WWF temperature rating methodology](#)”, CDP - WWF, October 2020.

<sup>14</sup> Scope 3 emissions are calculated as 43x the JBS disclosed level. In the original KPI, the level of reduction was linearly interpolated to 2026 to adjust for the shorter term. In the original KPI, Scope 3 emissions were kept flat from 2020, as no reduction is committed to. The original KPI is based on intensity – we are assuming zero change in meat production levels.

## Deforestation: Using scoring as KPI

JBS has long been pointed out by international organizations as one of the largest contributors to deforestation in the Amazon and Cerrado.<sup>15</sup> Trase Finance estimates that in 2017 alone, JBS S.A. was exposed to 38,560 Ha of deforestation risk.<sup>16</sup>

Despite the lack of accurate company-level data, deforestation is considered a key environmental issue for JBS and we opine that SLBs issued by the company linked to **a deforestation KPI would gain important credibility and appeal to a wider range of investors.**

### Deforestation risk

Current methodologies for corporates' carbon accounting do not account for emissions caused by deforestation. We assert that it should be included in SLB KPIs because:

- **Deforestation contributes to global warming.** Data shows that in 2016 and 2017, JBS Brazil was exposed to nearly 30Mt CO<sub>2</sub> from deforestation risk associated with its beef exports.<sup>17</sup>
- **Loss of biodiversity and habitat degradation.** *“The Amazon is an enormous reservoir of the planet's biodiversity, providing habitats for one out of every 10 of the planet's known species.”* Deforestation destroys homes, habitats and food sources for local species.<sup>18</sup>
- **Degradation of hydrological cycle.** Reduction in evapotranspiration from trees affects the regulation of rainfall patterns globally on top of exacerbating local droughts.<sup>19</sup> *“Changes in rainfall driven by tropical deforestation combined with warmer temperatures could pose a substantial risk to agriculture in key breadbaskets halfway around the world in parts of the U.S., India, and China.”*<sup>20</sup>

Figure 3. Deforestation risk associated with JBS's exports from different biomes. Source: Trase Finance.

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<sup>15</sup> Whereas the deforestation in the Amazon is widely known, the Cerrado might be an area that deserves more focus, see [“Brazil's other deforestation: has the savannah farming boom gone too far?”](#), Financial Times, 16 Aug 2022, for reference.

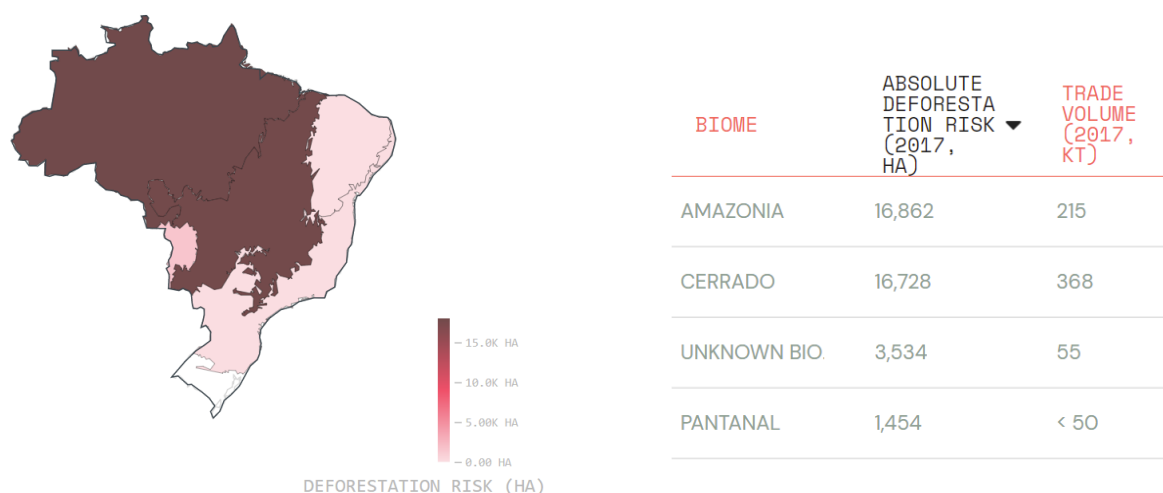
<sup>16</sup> [“Deforestation-risk green finance – more khaki than emerald”](#), Trase Finance, Dec 2021.

<sup>17</sup> Ibid.

<sup>18</sup> [“How deregulation, drought and increasing fire impact Amazonian biodiversity”](#), Nature, Sep 2021.

<sup>19</sup> [“Feedback between drought and deforestation in the Amazon”](#), IOP Science, April 2020.

<sup>20</sup> [“Effects of tropical deforestation on climate and agriculture”](#), Nature, January 2015.



Complex supply chains in the agricultural industry pose a real challenge for companies' deforestation monitoring, reporting and subsequent commitments capacity. A number of NGOs have demonstrated existing links between JBS and Amazon deforestation but very little data is being published with a level of accuracy suitable for systematic inclusion in a financial product.

Although JBS has made some commitments to ending deforestation in its supply chains,<sup>21</sup> the company does not currently report any data on actual deforestation within its supply chains. Nonetheless, the stickiness of Brazilian beef supply chains gives JBS huge leverage to implement efficient initiatives.<sup>22</sup>

### Developing the KPI

Among the few alternatives currently available,<sup>23</sup> we find the Forest500 score to be a viable option to inform the KPI for deforestation in this context (see Forest500 methodology in Annex B).

Forest500 assesses, on an annual basis, companies with the greatest influence on and exposure to tropical deforestation on the strength and implementation of their policies on deforestation and human rights. The score focuses on disclosure and commitment and companies are assessed against the information which has been made publicly available on their websites, or through reporting portals for certification schemes.<sup>24</sup>

JBS's 2021 Forest500 score is currently 42% and according to Forest500, five years should give ample time for JBS to implement an ambitious deforestation policy. It is thus reasonable to require a target score in the 80%-100% range by end of 2026.

In Table 2, we summarise our proposed additional KPI for JBS on deforestation.

<sup>21</sup> "[JBS 2020 Sustainability Report](#)", company webpage, accessed July 2022.

<sup>22</sup> "[Stickiness of supply chain configuration and trade flows of beef from Brazil](#)", Emilie Castin, Masters' thesis, UC Louvain, 2020.

<sup>23</sup> As an alternative, sophisticated third-party observation work is being undertaken by Trase Finance to disclose JBS's deforestation risk exposure but as the data is not currently released on a periodical basis, it is less suitable as an SLB KPI with contractual observation dates. Additionally, some commercial providers have worked on releasing periodic information about companies' exposure to deforestation but in a transparency effort, we favour publicly available options.

<sup>24</sup> "[Scoring methodologies 2021](#)", Forest 500 website, accessed 15 Aug 2022.

Table 2. Proposed KPIs for deforestation parameterization of an SLB for JBS. Source: AFII

Proposed KPI	
<b>KPI</b>	Forest 500 score
<b>Baseline</b>	2021
<b>SPT</b>	improving overall score from 42% to 80-100%
<b>End Observation</b>	2026

## Pricing an ambitious JBS SLB structure for significantly lower cost-of-capital

As a first step to see how the proposed KPI structure should affect pricing, AFII's SLB option-pricing framework<sup>25</sup> shows that more ambition should provide a higher option premium accruing to the issuer. An ambitious structure should provide lower cost-of-capital, as the investors have been provided with more optionality upside. Again, we would stress the difference in this approach as it deviates from the non-pecuniary/subsidizing process implied when market stakeholders are discussing "greeniums."

As a starting point to gauge what this structure could offer the issuer, an analysis of the current SLBs is useful. Using our SLB option-pricing framework, we estimate the step-up optionality value on the original SLBs to be 1.2bps (of yield/spread) for the JBSSBZ 3.625 01/32s and 0.4bps for the JBSSZ 3 05/32s. Detailed information on our pricing assumptions is provided in Annex C.

Table 3. Pricing of current SLB and proposed structure. Source: Bloomberg, AFII.

	JBS 3.625% 32s	JBS 3.00% 32s	AFII's proposed structure
<b>Maturity</b>	10.5 years		
<b>Currency</b>	USD		
<b>Coupon Frequency</b>	S/A		
<b>KPI 1</b>	JBS's Global Greenhouse Gas (GHG) Emission Intensity (Scope 1&2, in MtCO2 per million tonnes (MT) of product).	JBS USA's Global Greenhouse Gas (GHG) Emission Intensity (Scope 1&2, in MTCO2 per 100 lbs of product).	Absolute Scope 1, 2 & 3 emissions (MtCO2)
<b>SPT 1</b>	-16.36% by end of 2025 compared to a 2019 baseline <sup>26</sup>	-30% by end of 2030 compared to a 2019 baseline	-24% by end of 2026 compared to a 2020 baseline
<b>Coupon Step-Up 1</b>	25bps	25bps	40bps
<b>Coupon Step-Up 1 start date</b>	6 years	9.5 years	5 years
<b>KPI 2</b>	NA		Forest 500 score
<b>SPT 2</b>	NA		Score improvement from 42% (2021 baseline) to [80-100%]
<b>Coupon Step-Up 2</b>	NA		40bps
<b>Coupon Step-Up 2 start date</b>	NA		5 years
<b>Optionality value at the time of issuance</b>	<b>1.2bps</b>	<b>0.4bps</b>	<b>25bps</b>

<sup>25</sup> "An option pricing approach for sustainability-linked bonds", AFII Discussion Paper, Mar 2022.

<sup>26</sup> JBS targets a -30% reduction in GHG Emission Intensity by 2030 with linear progress in years 2025-2030. See "Second Party Opinion on JBS S.A.", ISS ESG, 8 Jun 2021.

The option premiums in the current SLBS are relatively small values stemming from a combination of structures with limited coupon step-ups, and sustainability targets that are relatively easy to achieve.<sup>27</sup>

Turning to a structure where we would apply the Scope 1, 2 and 3 absolute target, as well as the Forest 500 score target (Table 3, right-hand column), and use 2026 as a start date for potential step-ups of 40bps (rather than 25bps), our model indicates that the SLB should come 25bp inside a traditional bond.<sup>28</sup> See Annex C and Annex D for the pricing details of the separate KPIs. We set up the structure with one step-up per KPI to remove the need for modelling the correlation between KPIs.<sup>29</sup>

A clear advantage of the pricing model approach is that the step-ups and other parameters can be calibrated so as to achieve a targeted lower cost-of-capital for the issuer. In our example, we targeted 25bps as premium and backed out the 40bps step-ups from that. Therefore, JBS's potential interest cost savings for issuing USD1B of such an SLB would amount to USD26M.

Lifting the step-ups to 40bps is a reasonable option in a context of rising interest rates where the usual 25bps might sound cheap to investors.

## Conclusion

We see a clear advantage for JBS to be amongst the first issuers in the agricultural industry to come to the market with an SLB tackling both Scope 1, 2 and 3 emissions and deforestation.

In the light of growing concerns around SLBs' credibility, we believe investors would welcome a structure going beyond market standards that shows a strong commitment to tackling the company's key environmental issues. The sustainability impact of such an SLB would be substantial if the company were to meet its targets, improving JBS' environmental footprint whilst establishing best-in-class standards within the agricultural sector-labelled debt market.

Using our pricing framework, we demonstrate JBS could achieve a significant greenium (hence a lower cost-of-capital) under modest assumptions aligned with the company's own sustainability commitments. Looking ahead, we hope our approach provides investors and JBS a basis for raising the ambition of the company's future SLB issuances.

You can find this and over 80 pieces of research designed to help bond investors with the climate transition [here](#).

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<sup>27</sup> The increase in option premium (difference in spreads) between the 3.625s and 3s mainly stem from an earlier (6y) step-up start date for the 3.625 vs the 3s (9.5y). Even if the former has a substantially longer pay-out time, this only manifests itself in a 0.8bps pricing spread differential. Note that differential will be proportional to the difference in payout time: the 1.2bps optionality value in the 3.625s reflects that will be paying out for five years, whereas the 3s will pay out for two years. The ratio  $5y/2y=2.5x$  closely resembles the ratio between optionality values  $1.2/0.4=3x$ .

<sup>28</sup> This may sound high, but use [TDCNET 5.056 05/31/28 Corp](#) as a yardstick. The TDC SLB is paying a 30bps coupon step-up per SPT not met. SPT1 is tied to a reduction in Scope 1 and 2 emissions whilst SPT2 is linked to a reduction in Scope 3 emissions.

<sup>29</sup> Note that the correlation between the KPIs still persist insofar that it is unlikely that JBS will reach the proposed CO2 reduction target (including Scope 3) unless the company also addresses deforestation.



## Annex A: JBS emissions and credit curve

There were many critics regarding the targets of the sustainability linked bonds of JBS, issued in June and November 2021. The bonds, JBSSBZ 3.625 01/32s<sup>30</sup> and JBSSBZ 3 05/32s<sup>31</sup> are focusing on reducing emission (intensity) of the company, with further details discussed below.

JBS reports numbers for Scope 1, 2 and 3, where Scope 3 is around 10% of the total, but in terms of its recent SLBs, only Scope 1 and 2 are targeted. The ISS ESG opinion on JBS S.A. (Jun-2021) notes that the majority of emissions are Scope 3.<sup>32</sup> The opinion on JBS USA Lux S.A. (Nov-2021) reports that Scope 3 represent 96% of total GHG emissions.<sup>33</sup> Further to this, CDP analysis estimates that JBS Scope 3 emissions are 43x their disclosure, making up 80% of the total.<sup>34</sup>

The statement in the first SLB SPO that the carbon reduction KPI is “not material to the whole corporate value chain as the KPI does not include Scope 3 emissions” gives a clear indication of the provider’s viewpoint.

Depending on source, total emissions estimates for the company (Scope 1, 2 and 3) range between 6.79 MtCO<sub>2</sub> (JBS disclosure) to 155.11 MtCO<sub>2</sub> (CDP estimate - increasing Scope 3 to 96% of total). An alternative way to express this is that the company’s carbon footprint is equivalent to between one to 22 coal-fired powerplants.<sup>35</sup> A commitment to meaningfully reduce these emissions would be welcomed from such a company, and we would expect investors to be eager to use their capital to assist.

In June 2022, JBS issued a new batch of bond across the maturity spectrum, from long-5yr to 30yr, part as new financing and part to refinance older high-coupon bonds that were being tendered. Another tender was announced on 2 Aug 2022, including the JBSSBZ 3.625 01/32s. Interestingly, as Figure 4 indicates, the JBS SLBs from the USA vs Luxembourg entities have traded at a substantial spread differential.

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<sup>30</sup> Jun-21 issue, USD1bn, ISINs USL5S59NAA30 (REGS), US46592QAA76 (144a). Issuing entity JBS USA.

<sup>31</sup> Nov-21 issue, USD1bn, ISINs USL56608AG44 (REGS), US46590XAD84 (144a). Issuing entity JBS Luxembourg.

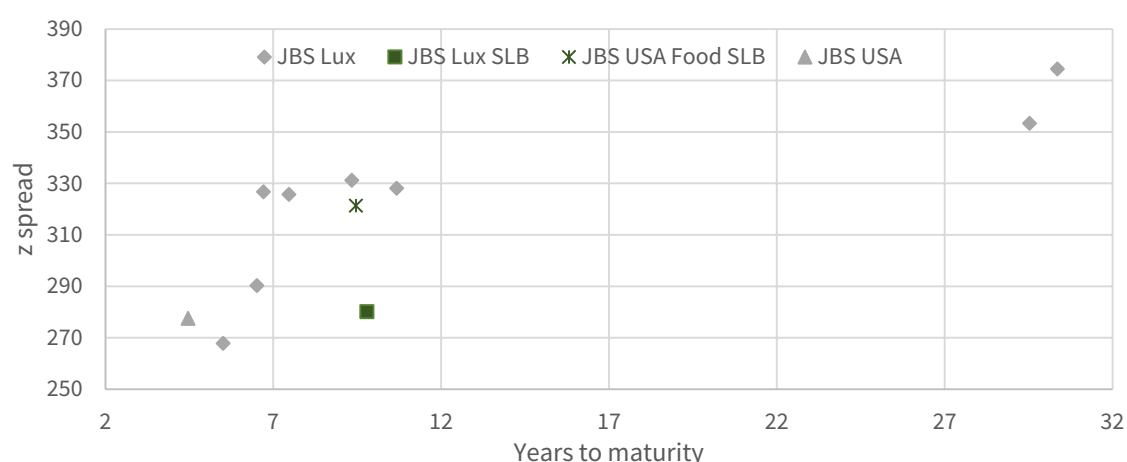
<sup>32</sup> “[Second Party Opinion on JBS S.A.](#)”, ISS ESG, 8 Jun 2021.

<sup>33</sup> “[Second Party Opinion on JBS USA Lux S.A.](#)”, ISS ESG, 15 November 2021.

<sup>34</sup> Calculations through the [CDP website](#), accessed June 2021.

<sup>35</sup> We assume mid-sized, super-critical plants of around 1,600MW, which would be associated with emissions between 6-8Mtpa.

Figure 4. USD bonds (benchmark) from JBS through varying issuing entities and including SLBs. Source: Bloomberg, AFII.



## Annex B: Forest 500 score methodology

Forest 500 assesses and ranks annually the companies that have the highest exposure to forest risk commodity (FRC) within their supply chains. Thanks to a comprehensive set of indicators, the score tracks the progress of commitments towards addressing potential deforestation in palm oil, soy, beef, leather, timber, and pulp and paper supply chains, as relevant to each company's operations. The methodology was created in 2014 and has been reviewed annually by Global Canopy and external experts working on these issues. Companies are assessed against four categories:

- Overall approach: company-wide deforestation commitments and high-level management position focused on deforestation.
- Content of commitments: scope and ambition relevant to the company's operations.
- Social considerations
- Reporting and implementation

Although the score relies more on reporting and commitment rather than tracking actual impacts on deforestation, we believe it can in general be considered reliable as it is based on public information, transparent and publicly available to the market. Moreover, the score is released annually on a defined period, as for most sustainability KPIs.

Some limitations to the methodology as listed below:

- The methodology is subject to future amendments and score calculations are not externally audited.
- The methodology might rate positively a company highly exposed to deforestation but with a good level of reporting and commitments.
- Companies need an extensive workstream to go through the methodology and assess what is required to improve their score

## Annex C: KPI1 Pricing

As detailed in our original SLB pricing paper,<sup>36</sup> carbon emissions can be described by a geometric Brownian motion and we can use the closed form of Black-Scholes formula to price the optionality associated with coupon step-ups.

The first step of this pricing procedure is to calibrate the key pricing parameters: the drift and volatility. These metrics essentially define the law-of-motion for the KPIs from which we infer probabilities around the likelihood that the Sustainability Performance Targets (SPT) will be achieved.

First, the drift is essentially the trend along which we can expect the KPI to evolve, and can, in the context CO2 emission, be interpreted as carbon emissions improvement expectation of the market. For example, investors seeking to align their portfolio with IPCC 1.5 degrees scenario should consider a drift of -5.80% p.a. in order to be aligned. This calculation is derived from the Intergovernmental Panel on Climate Change,<sup>37</sup> and is discussed in more detail in our SLB pricing paper.

Second, one needs to assume a certain volatility around the trend. The most direct approach is to estimate historical volatility in the KPI data. We choose to calibrate the historical volatility based on Scope 1 and 2 emissions as we are provided with limited Scope 3 emissions data of dubious quality and believe it to be an acceptable proxy. Based on the observed data, we calculate the historical volatility at 17.4% between 2014 and 2021.

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<sup>36</sup> “[An option pricing approach for sustainability-linked bonds](#)”, AFII Discussion Paper, Mar 2022.

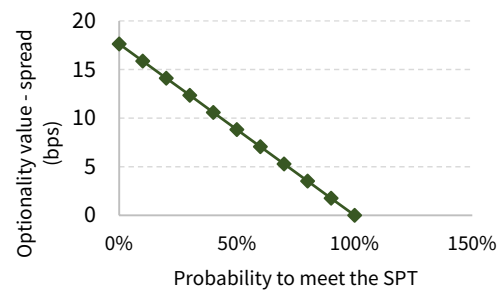
<sup>37</sup> “[Special Report on the impacts of global warming of 1.5 degrees](#)”, IPCC, 2018.

## Annex D: KPI2 pricing

Whereas carbon emissions can be modelled with a Brownian motion, scores – such as the proposed KPI2 deforestation score – are by nature deterministic and constrained by upper and lower boundaries, requiring a different methodology to infer probabilities to meet SPTs and subsequently trigger coupon step-up payments.

Looking at the empirical evolution of scores in the Forest500 database, 23% of companies improve their score over a five-year horizon. JBS currently scores a 43% which is in the second-best quartile of scores, even if it is not an impressive number in absolute. Indeed, the majority of companies have seen decreasing scores over the past five years with 59% having suffered a relative decrease of 20% or more. This clearly highlights an increase in deforestation activities (or at least the measurement thereof).

Figure 5. Optionality value relative to the probability to achieve the deforestation SPT. Source: AFII.



Given a closer scrutiny of and higher focus on deforestation, not least in the context of climate impact, we expect future trajectories of scores to be quite different from historic. So, looking for potential improvements in scores going forward, we observe that 19% of covered companies experienced a relative increase in their scores of 20% or more over this period, and so consider this our baseline of being a responsible company who can achieve a larger increase in the future.

We are mindful that some investors might have a different view of JBS's probability to reach this target and illustrate this sensitivity in Figure 5

Based on our SLB option pricing approach<sup>38</sup>, we evaluate the optionality premium as follows:

$$\sum_{t=0}^n \frac{C'_t - C_t}{B(O, t)} = P(\text{Score} \leq 80\%) \cdot \sum_{t=\tau}^n \frac{CSU_t}{B(O, t)}$$

with

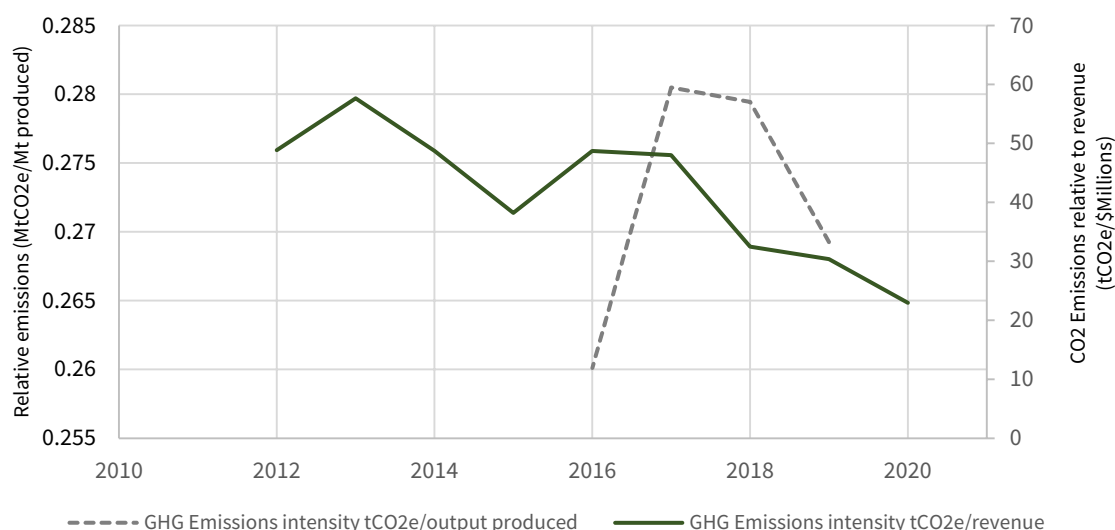
- $B(O, t)$  the discount factor
- $t_\tau$  the SPT observation date
- $C'_t - C_t$  the spread between the SLB and the traditional bond equivalent fixed coupon rates, i.e. the *optionality premium*.
- $CSU_t$  the value of the coupon step-up at time  $t$
- $P(\text{Score} \leq 80\%)$  the score's probability to be below its target.

<sup>38</sup> Ibid.

## Annex E: JBS 3.625% 32s and JBS 3.00% 32s pricing

The first step for evaluating JBS 3.625% 32s and JBS 3.00% 32s coupon step-up optionality is to calibrate pricing parameters. Those two SLBs are linked to emissions intensity relative to output (million tonnes (MT) of product). Unfortunately, we are provided with a limited sample size and cannot calculate historical volatility and drift with an acceptable level of confidence. As an alternative, we proceed by using emissions intensity per sales – for which there is more data – as a proxy, taking the assumption that revenue is highly correlated with output produced. Using this proxy, we estimate the historical volatility at 21%.

Figure 6. JBS's emissions intensity relative to revenue vs. output produced. Sources: Bloomberg, AFII



Choosing the “drift” parameter interpreted as the minimal rate of KPI improvement as required by the market is a difficult exercise. On one hand investors should require companies to align their emissions trend with IPCC and/or SBTi Frameworks but on the other hand, it will be a difficult exercise for JBS to drastically cut their emissions in the medium/short term in view of their business model (unless ground-breaking discoveries to stop cow’s enteric fermentation). In that context, investors need to carry out a balancing exercise between requiring realistic targets from companies and aligning their portfolio with Paris Agreements. We make the deliberate choice in this paper to apply a drift aligned with IPCC1.5 degrees target (i.e. -5.80% p.a.) in an effort to push for ambition in a sector that is increasingly contributing to global warming.

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