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Sustainability-linked Finance: A Lever for Firm-Level Resilience Innovation

Jose L. Resendiz, Nicola Ranger, Olivier Mahul[1]

ABSTRACT *Sustainability-linked finance (SLF) offers a promising pathway to close the corporate adaptation finance gap by linking borrowing costs to climate-resilience performance. However, current instruments fall short of their potential. Analysing 701 SLF instruments issued by 395 firms across real estate, electric utilities and agrifood, we compare embedded key performance indicators (KPIs) with those disclosed in sustainability reports. Across adaptation, resilience and combined MAR (mitigation–adaptation–resilience) themes, firms report 2,619 relevant KPIs, yet only 511 (19.5%) are embedded in financial contracts—leaving 80.5% unenforced. This fourfold gap highlights a significant opportunity to expand SLF coverage using metrics firms already track. The bottleneck is not data availability but a lack of standardised, verifiable A&R benchmarks. We propose a suite of process-based KPIs and contractual mechanisms to bridge this gap, enabling SLF to evolve into a credible, scalable tool for embedding climate resilience into corporate strategy and unlocking private capital for adaptation.* (*JEL* Q56, Q54, G32, O32)

Climate change is no longer a remote forecast; it is a present financial and strategic threat. Physical climate extremes, such as floods, droughts, wildfires and heatwaves, have intensified by over 35% since the 1990s (IFRC, 2020), causing profound disruptions to global supply chains and corporate cash flows. As global temperatures rise beyond 1.2°C above pre-industrial levels (IPCC, 2023), the costs of inaction are escalating faster than previously modelled. Yet the financing required to build adaptive capacity remains sorely inadequate (WEF, 2022): current adaptation and resilience (A&R) flows represent less than 3% of global climate finance and fall hundreds of billions short of projected needs (GCA & CPI, 2023; UNEP, 2022). Bridging this A&R finance gap is not only urgent but economically rational. While the public

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sector has historically underwritten most A&R investment, future progress hinges on mobilising private capital at scale (ARIC & CPI, 2022) and enabling firms to adapt. However, private actors face a conundrum: how to price, prioritise and operationalise adaptation when climate risk is uncertain, future-oriented and poorly rewarded by markets. This paper addresses that challenge by exploring how sustainability-linked finance (SLF) can serve as an effective mechanism to realign financial incentives and unlock firm-level innovation in climate resilience. It complements previous work on biodiversity and SLF (Resendiz et al. 2025).

Despite increased interest in sustainable finance, current instruments have skewed heavily toward climate mitigation. Green bonds, for instance, have contributed to adaptation projects in certain cases, accounting for 16% of labelled proceeds up to 2020 (GCA, 2021), yet they frequently lack the contractual enforceability required to effect behavioural change (Caldecott, 2022). Moreover, conventional debt tools tend to rely on earmarking capital for use-of-proceeds, which limits flexibility and fails to account for the dynamic, process-based nature of adaptation. A growing literature highlights structural barriers to private A&R investment: imperfect information (Canevari-Luzardo et al., 2020), uncertain returns (Linnenluecke et al., 2015), and credit frictions that penalise exposed borrowers (Grover & Kahn, 2024). In parallel, the role of price signalling through capital markets has received inadequate attention in adaptation discourse. SLF, debt whose terms adjust based on performance against sustainability key performance indicators (KPIs), emerges as a promising lever. Unlike green bonds, SLF embeds forward-looking accountability by contractually linking cost of borrowing to A&R performance targets. These margin ratchets can shift adaptation from a discretionary initiative to a priced managerial obligation, making climate resilience a financial variable rather than a reputational afterthought.

This paper investigates the untapped potential of SLF to support climate A&R by assessing how prepared current market participants are to embed A&R performance indicators into SLF frameworks. Rather than evaluating the realised impact of SLF instruments, we focus on the headroom available for deeper integration of resilience metrics into pricing covenants. Drawing on a novel dataset of SLF instruments and issuer sustainability reports, we measure the extent to which material A&R topics disclosed by firms are hard-wired into their debt contracts. This gap analysis, supported by targeted case studies, allows us to identify latent alignment

opportunities across sectors. Complementing the empirical findings, we construct a theoretical business case for SLF as a lever for overcoming core market failures that hinder private investment in adaptation—specifically, weak price signals, capital market frictions, and fragmented risk information. In doing so, we highlight how SLF could serve as a scalable architecture for mainstreaming corporate climate resilience.

We construct a global dataset of 701 SLF instruments issued between 2017 and 2023, representing 395 non-financial corporates across three sectors (electric utilities, real estate and agrifood) that account for over one-third of global SLF issuance. For each issuer, we match SLF documentation to the firm's sustainability reports, extracting and classifying over 3,700 material KPIs and identifying the subset of 1,249 KPIs embedded in loan and bond covenants. These metrics are then mapped to an A&R taxonomy adapted from the EU Taxonomy, Global Centre on Adaptation (2021), the Climate Bonds Initiative (2019) and Sadler et al. (2023). A Gap Index is computed for each firm, defined as the proportion of material A&R topics that are excluded from SLF contracts. To supplement the quantitative analysis, we conduct in-depth case studies of six issuers to assess design heterogeneity, alignment with A&R strategies, and the operationalisation of resilience within SLF frameworks.

Our analysis reveals significant untapped potential to embed A&R metrics into SLF instruments. Across adaptation, resilience, and MAR (mitigation–adaptation–resilience) themes, issuers have reported 2,619 relevant KPIs in their sustainability reports over the past seven years. Yet only 511 (19.5%) have been embedded in SLF contracts, leaving 80.5% of material metrics unenforced. This implies SLF coverage could expand more than fourfold before exhausting the existing pool of disclosed KPIs. Adaptation KPIs show the widest headroom, with a gap of 99.5%, followed by resilience at 83.2%. In contrast, mitigation KPIs are far more established, with a lower 58.5% gap. This reflects a broader market pattern: while mitigation metrics (e.g. GHG emissions, energy use) dominate SLF structures, A&R KPIs remain largely excluded. The reasons are not technical (many firms already track A&R indicators internally) but structural: the market lacks standardised pricing models, verification protocols, and investor demand for enforceability. Sector-level differences also matter: real estate firms show stronger KPI alignment due to more codified ESG standards, while electric utilities trail despite strong risk modelling capabilities. Encouragingly, leading transactions

such as COFCO's drought-linked loan and Bimbo's wastewater-reuse bond signal early innovation. With 51% of issuers already disclosing A&R KPIs in their sustainability reports, there is a clear opportunity to convert this latent content into contractual terms—strengthening accountability, improving risk signalling, and accelerating capital flows toward real climate resilience.

This study contributes to three interrelated literatures: sustainable finance, corporate adaptation, and financial innovation. First, we offer the most comprehensive empirical mapping to date of how A&R metrics are, or are not, translated into contractual obligations in SLF. Second, we develop and apply the Gap Index, a replicable benchmark for evaluating incentive alignment between voluntary disclosures and priced commitments. Third, we articulate three distinct SLF mechanisms (KPI-driven pricing, resilience-related hedging, and mandatory disclosure) that address the canonical constraints on private adaptation investment. These findings support the emerging view that SLF is not merely a tool for reputational signalling, but a strategic lever for embedding resilience into firms' financial strategies. As such, SLF offers a scalable platform for transition finance that aligns corporate action with both local adaptation plans and global climate goals, and feeds into discussions on transition plans.

The remainder of the paper is structured as follows. Section I outlines the theoretical foundations for SLF as a resilience-financing tool. Section II details the methodology, including the Gap Index and KPI extraction. Section III presents the main findings by sector and instrument. Section IV discusses implications for finance, governance, and standards. Section V concludes with recommendations to scale SLF for adaptation, particularly in emerging markets.

I. Unlocking Firm Resilience Innovation

Physical climate hazards are no longer a distant concern; they already affect corporate cash-flows through their impact on profits, and investors incorporate these risks into financing costs. Firms operating in regions susceptible to heat stress, extreme weather or sea-level rise face lower expected earnings and higher borrowing costs (Acharya et al., 2024; Addoum et al., 2023). When future physical risks are imperfectly priced, firms lack a financial signal strong enough to justify investment in adaptive capability. We argue that SLF provides such a signal

by contractually tying debt servicing costs to pre-defined sustainability performance targets (SPTs). Therefore, by shifting part of tomorrow's climate damages into today's borrowing rate, SLF transforms latent climate risk into an explicit managerial incentive (Poggensee, 2025).

The conceptual foundation for this claim rests on three pillars of the economics of firm adaptation summarised by Grover and Kahn (2024). First, consistent with Ehrlich and Becker's (1972) self-protection model, rational managers invest in adaptation up to the point where the marginal cost of adaptation equals the marginal reduction in expected damage, thereby minimising the sum of adaptation expenditure and residual risk. Second, capital market frictions, such as asymmetric information, credit rationing, and the high cost of external finance, can significantly suppress adaptive investment, particularly for firms with limited internal funds or facing uncertain returns (Albert et al., 2024; Bloom et al., 2025). Third, information on climate-related physical hazards is repeatedly distorted and delayed as it passes between tiers of a supply chain, so most firms only update their beliefs after shocks are realised; this slow and noisy diffusion of risk intelligence prevents the network from mobilising timely, collective adaptation (Lee et al., 1997; Pankratz & Schiller, 2024).

Having outlined the conceptual barriers that firms face when deciding whether and how much to invest in climate adaptation, namely the difficulty of valuing future losses, the cost and scarcity of external finance, and the delayed transmission of risk information, we now examine the operational mechanisms through which SLF can alleviate these constraints. Unlike use-of-proceeds instruments, SLF does not earmark capital for specific adaptation projects.[2] Instead, it embeds forward-looking incentives into debt contracts, making the cost of capital responsive to performance against pre-defined resilience metrics. The following three mechanisms trace a one-to-one correspondence with the conceptual pillars described above, showing how contract design can realign managerial incentives, reduce frictions in financial markets, and strengthen information flows across corporate networks.

[2] Other financial instruments that are specifically designed to close the investment gap in A&R include green bonds, resilience bonds, and climate adaptation funds. Green bonds, for instance, raise capital specifically for projects that mitigate or adapt to climate risks, directly channelling funds into resilience-enhancing initiatives (Qadir & Creed, 2021). Resilience bonds, a sub-set of green bonds, finance resilient infrastructure projects reducing large-scale risks in future disasters (Motlagh et al., 2024). Climate adaptation funds, often supported by public and philanthropic capital, are explicitly targeted at financing projects that enhance resilience in vulnerable regions, particularly in developing countries (e.g., Adaptation Fund, 2022).

KPI-driven cost-of-capital adjustment. When coupon step-ups or step-downs hinge on measurable A&R targets, the expected financing spread becomes an explicit shadow price for climate damage. This pricing influences investment decisions by raising the required return for new projects. While higher capital costs typically delay investment, under uncertainty and irreversibility, they can also hasten action when the benefit of avoiding future climate loss outweighs the option to wait (Gutiérrez, 2021). Moreover, linking coupon step-ups or step-downs to verifiable A&R KPIs curbs moral hazard without costly on-site monitoring (Aleszczyk et al., 2022). For instance, a coastal logistics operator that issues a medium-term SLB with a step-up in interest rates if cumulative flood-hardening expenditure falls below a set share of revenue within a few years is incentivised to accelerate resilience investment that might otherwise be postponed. The contract transforms a probabilistic future cost into a near-term financial penalty, bringing adaptation decisions forward in time.

Risk-transfer and liquidity enhancement. Capital market frictions intensify when firms are exposed to correlated climate shocks without access to risk-transfer or liquidity instruments, amplifying the cost of external finance. SLF can address this constraint by tying margin reductions to the adoption of verifiable hedging strategies, such as parametric insurance or contingent credit lines. These arrangements preserve internal liquidity and reduce expected distress costs, consistent with theories of hedging that prioritise investment continuity over pure risk aversion (Froot et al., 1993). They also reduce time-varying financing constraints by providing collateral substitutes when firms face negative shocks (Rampini et al., 2014). Consider an agrifood processor that qualifies for a modest interest rate discount if it maintains either drought index insurance covering most of its maize inputs or access to an undrawn credit facility sufficient to cover a quarter's operating costs. By signalling credible post-shock liquidity, these instruments lower lenders' perception of credit risk and unlock more favourable financing terms.

Contractual risk-information sharing. Climate hazard information often degrades as it travels through corporate supply chains, slowing firms' responses to emerging threats. SLF instruments help to address this problem by requiring borrowers to publish regular climate risk data that is verified by a third party. In the terms of Morris and Shin (2002), such disclosure requirements shift the informational environment toward a credible disclosure equilibrium. The

verified data acts as a more precise and commonly observed public signal, which agents rely on more heavily than fragmented private information. This raises the marginal value of accurate public disclosures and reduces the dispersion of posterior beliefs, thereby facilitating faster and more coordinated responses to risk. Moreover, shared exposure data improves collective decision-making across production networks, mirroring findings in supply chain theory on the benefits of information visibility (Cachon & Fisher, 2000). A semiconductor manufacturer that ties its interest rate discount to the completion of independent flood risk audits by the vast majority of its direct suppliers not only deepens its own understanding of vulnerabilities, but also spreads essential hazard information across its value chain. This enables pre-emptive measures, such as relocating at-risk suppliers, and strengthens overall system resilience.

Taken together, these mechanisms illustrate how SLF can internalise climate-related externalities by reframing adaptation as a financially salient objective. By aligning contract structure with theoretical constraints on firm behaviour, SLF instruments convert abstract climate risk into concrete managerial incentives, reduce the cost of hedging and liquidity provision, and accelerate the diffusion of actionable information. In doing so, they offer a scalable, market-based pathway for mobilising private capital towards organisational and supply chain resilience, even in the absence of targeted subsidies or public mandates.

II. Methods

In this section, we describe the methodological approach used to construct the dataset, extract and classify sustainability KPIs, calculate the gap index, and conduct complementary case studies. This includes data collection from SLF instruments and sustainability reports, the application of a machine learning pipeline for KPI identification, and the use of a structured framework to analyse alignment across sectors.

Data universe and sampling.—All SLF instruments issued worldwide between 1 January 2017 and 30 June 2023 were retrieved, without any minimum deal-size filter, from Environmental Finance's database (for KPI metadata) and from Bloomberg (for financial descriptors and de-duplication). The search yielded 523 SLLs and 178 SLBs issued by 395

non-financial corporates across developed and emerging markets; all monetary values were already denominated in USD. We retained only instruments from Real Estate, Electric Utilities and Agri-Food because, together, these sectors accounted for 36 % of global SLF issuance over the study window, whereas the remaining 64 % lay mainly in resource-transformation, mineral extraction, processing and transport industries. After this sector screen the instruments' exposure was 47 % real estate, 31 % electric utilities and 29 % agrifood, with percentages exceeding 100 % because some issuers straddle more than one sector. For each of the 395 corporates we inspected their sustainability reports matching the year of issuance (or, where reporting cycles required, the immediately following year), creating a matched corpus of 395 reports for subsequent KPI extraction.

KPI corpus construction and classification scheme.—All text from the 395 sustainability reports was converted to plain text with PyPDF2, split into 600-word overlapping chunks, embedded with the OpenAI text-embedding-3-small model and stored in a FAISS index. A retrieval-augmented GPT-4o chain (temperature 0.0) queried the index with prompts enriched by a sample of 100 sustainability metrics, returning the five most similar chunks per query and surfacing candidate KPIs; a 10 % hand-check yielded Cohen's $\kappa = 0.82$ and an F1-score of 0.89. This means that the manual review aligned with the model's output 82 % more often than would be expected by chance, and the automated system produced the correct result in nearly nine out of ten cases when accounting for both precision (few false positives) and recall (few missed KPIs). Full technical details of this RAG workflow are described in Appendix A, while Appendix B sets out the KPI classification rules.

Extracted metrics were mapped to the SASB hierarchy and then re-tagged into four outcome classes—mitigation, adaptation, resilience and MAR (combined benefits)—using an amalgamated taxonomy derived from the EU Taxonomy, Sadler et al. (2023), the Global Centre on Adaptation and the Climate Bonds Initiative; composite ESG scores reported by external rating agencies were captured separately and labelled 'non-SASB'. To avoid overweighting firms that disclose many near-identical measures, we retained only one exemplar KPI per SASB sub-topic: when several candidates existed (e.g. ten water-use indicators), two reviewers selected the instance with the richest metadata (units, baseline, target and time frame).

Gap-index construction.— The gap index gauges how faithfully a firm's SLF instruments mirror the breadth of sustainability topics it proclaims elsewhere. We tally the distinct KPI themes embedded in each bond or loan covenant, map them to the SASB taxonomy to eliminate near-duplicates, and compare that count with the total KPI themes the issuer discloses in its sustainability report. Operationally, we calculate the index by taking one minus the proportion of KPI topics that appear in an issuer's SLF instruments out of the combined set of topics found in both the instruments and the report. A score of zero denotes full alignment, whereas a score of one indicates that none of the public commitments are tied to financial penalties; intermediate values show partial coverage. A high gap index can flag potential green hushing: companies may showcase an impressive suite of environmental pledges in voluntary reports yet choose to hard-wire only a select, often less demanding, subset into debt instruments where missing a target would raise their cost of capital. In effect, the metric quantifies the caution – or strategic restraint – with which management translates headline sustainability claims into accountable, price-sensitive obligations, offering a practical signal for investors assessing credibility and incentive alignment in sustainable finance.

In-depth case studies.— To complement the quantitative analysis, we conducted six in-depth case studies selected from issuers operating within the three focal sectors of our sample: real estate (Link REIT, Gecina), electric utilities (Enel, Iberdrola), and agrifood (Bimbo, COFCO). These case studies were chosen to illustrate variation in the design and ambition of SLF frameworks and to explore how A&R considerations are integrated—or omitted—across different corporate and sectoral contexts. Selection was guided by a structured three-part framework adapted from IRIS's Five Dimensions of Impact, the Climate Bonds Initiative's Climate Resilience Principles, ICMA's Climate Transition Finance Handbook, and the LMA Sustainability-linked Loan Principles. The framework assessed each case on: (i) the structure and objectives of the SLF instrument, (ii) the quality and specificity of its KPIs and targets, and (iii) the treatment of climate-related risks, opportunities and implementation challenges related to A&R. Within each sector, we intentionally selected one issuer with high alignment between its SLF and broader sustainability disclosures, and one with a pronounced KPI gap, in order to capture contrasting practices. These qualitative insights serve to contextualise the

empirical findings, revealing mechanisms and sector-specific dynamics that may not be apparent from aggregated data alone. Further details are provided in Appendix C.

III. Results

Sample coverage and instrument landscape.— The dataset comprises 701 sustainability-linked finance instruments with an aggregate face value of USD 452 billion (Table 1). Developed-market borrowers supply roughly two-thirds of both sustainability-linked loans (SLLs) and bonds (SLBs). In terms of sectors, Real Estate contributes 47% of all instruments and just under 30 % of total volume, propelled by the surge in green-building certification and retrofitting finance in Europe and North America. Electric Utilities account for the largest share of financing volume (31%), reflecting the capital intensity of grid decarbonisation, while Agrifood represents 29% of issuances, signalling growing investor attention to sustainable agriculture and supply-chain resilience. In all, the sample spans 395 non-financial corporates and 271 arranging banks, providing a broad cross-section for the alignment analyses that follow.

TABLE 1. Descriptive summary of SLF by market and instrument

Instrument	Market	SLF Count (n, %)	Volume (USD bn, %)	Issuers (n)	Banks (n)	SR KPIs (n)	SLF KPIs (n)
SLL	Developed	335 (64.05%)	231.77 (69.88%)	200	187	1845	658
SLL	Emerging and Other	188 (35.95%)	92.15 (30.12%)	138	119	875	300
SLB	Developed	119 (67.23%)	52.65 (35.95%)	51	51	722	213
SLB	Emerging and Other	59 (33.33%)	93.80 (64.05%)	37	66	302	78
Total	All	701 (100%)	452.37 (100%)	395	271	3744	1249

Note. “SLF Count” and “Volume” report, respectively, the number of SLF instruments and their aggregate amount in billions of USD, with the percentage (%) relative to each instrument’s grand total. “Issuers” and “Financial Institutions” count distinct entities (see table FI). “SR KPIs” aggregates all industry-specific material KPIs as defined by SASB (one representative KPI per SASB category) plus an additional category for ESG

Scores/Ratings; "SLF KPIs" is the subset of those material KPIs explicitly embedded in the SLF documentation (hence always ≤ SR KPIs).

Figure 1 contrasts the pool of KPI themes disclosed in issuers' sustainability reports ("SR KPIs") with those embedded in pricing covenants ("SLF KPIs"). Developed-market firms cite nearly 1900 KPI topics in their reports but hard-wire fewer than 800 into debt documentation; their emerging-market peers disclose just over 600 and embed about 270. On average, an SLF instrument integrates 1.78 SLF KPIs, compared to 3.56 SR KPIs, based on SASB-defined material sustainability categories. This suggests that many material metrics remain effectively voluntary and carry no price consequence. The largest omissions relate to adaptation and resilience, foreshadowing the alignment gaps explored in subsequent sections.

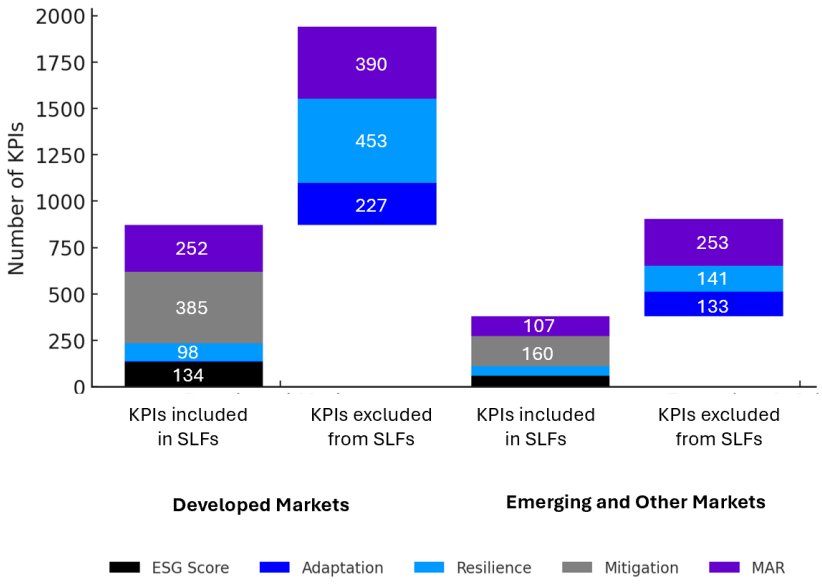


FIGURE 1. Distribution of KPIs included and excluded in SLF instruments across market classifications

Note. KPI topics are grouped by sustainability theme (Mitigation, Adaptation, Resilience, MAR, and ESG Score). Market classification follows the MCI 2025 framework: Developed Markets include high-income OECD countries; Emerging Markets include middle-income economies with established capital markets; Other Markets comprise frontier, advanced frontier, and non-classified economies.

Of the 1,135 KPI topics hard-wired into our loan and bond sample, fully 35 % relate to GHG-emission intensity, a further 20 % to energy management and 9 % to water management.

By contrast, adaptation or enterprise-resilience levers are scarce: climate-change adaptation, critical-incident risk and systemic-risk management together account for less than 1% of the total, while broader "business-model resilience" adds only another 3.5%. Roughly 12% of KPIs are generic ESG scores, suggesting that many issuers still rely on composite ratings rather than topic-specific metrics when translating sustainability commitments into pricing terms. On structure, the great majority of KPIs are backed by a numeric target (identical counts for 16 of 17 SASB themes) and nearly 99% specify a baseline year, indicating that once a metric is chosen it is typically framed in a measurement-ready way. The pattern supports the case-study observation that firms and lenders converge quickly on mitigation-friendly indicators with well-established accounting rules (e.g., GHG, energy), whereas adaptation and resilience datapoints, despite being tracked internally by issuers such as Gecina or COFCO, remain largely outside the covenant set, likely because verification protocols and market conventions are still emergent.

TABLE 2. SLF Headroom by KPI category: measuring the gap between disclosure and enforcement

Category	Total KPI Obs.	SLF Obs.	Headroom Obs.	Headroom %
Mitigation	932	545	387	41.5 %
Adaptation	364	2	362	99.5 %
Resilience	894	150	744	83.2 %
MAR	1 361	359	1 002	73.6 %

Note: Headroom is calculated as the difference between the number of KPI observations disclosed in issuers' Sustainability Reports (SR) and those contractually embedded in SLF instruments. The headroom % expresses this gap as a share of SR observations. Categories are defined as follows: Mitigation—KPIs that reduce greenhouse-gas emissions or energy use; Adaptation—KPIs addressing physical-climate risks such as heat, drought or flooding; Resilience—broader indicators that strengthen socio-ecological or community capacity, including nature-based solutions and social-justice considerations; MAR—KPIs that deliver combined Mitigation, Adaptation and Resilience benefits, reflecting integrated climate-resilient pathways.

Table 2 shows that SLF documentation still trails issuers' disclosures. Mitigation metrics, backed by clear accounting rules, translate most effectively into pricing covenants, leaving a headroom of 41%. Adaptation KPIs are almost entirely absent: fewer than 1% of the 364 adaptation observations in sustainability reports appear in any loan or bond covenant, creating

a 99.5% gap. Resilience performs only slightly better, with an 83% headroom despite rising concern about supply-chain risks. Multi-benefit MAR KPIs, which address mitigation, adaptation and resilience in tandem, show a 74% gap, indicating that integrated climate-resilient pathways remain largely aspirational. In total, across adaptation, resilience and MAR themes combined, issuers report 2,619 KPIs but embed only 511 in SLF instruments—an uptake of just 19.5%, leaving an overall headroom of 80.5%. In other words, SLF coverage could expand by over four-fold before exhausting the pool of material KPIs already disclosed. Taken together, these figures underscore both the early stage of A&R-linked debt and the sizeable opportunity for standard setters, lenders and arrangers to close the gap between disclosure and enforcement.

Alignment gap across sectors.— The Gap Index reveals persistent misalignment between the sustainability topics firms disclose and those they embed in financial instruments, with notable variation across sectors. While all three sectors show substantial gaps, Electric Utilities display the highest average divergence—possibly reflecting the tendency to focus SLF instruments on headline mitigation targets, while adaptation and resilience indicators remain largely confined to corporate disclosures. Case study insights suggest that, even when data and risk assessments are available—such as Enel's investment in grid resilience or Iberdrola's water stress analytics—these do not always translate into pricing-relevant KPIs, potentially due to complexity, replicability challenges, or uncertainty about investor expectations. In contrast, Real Estate and Agrifood issuers show slightly narrower alignment gaps, but with greater dispersion. This may reflect a mix of practices: firms like Link REIT and Gecina have begun integrating climate risk assessments and GRESB-derived indicators directly into SLF frameworks, while others rely more heavily on reputational ESG signals or defer adaptation KPIs to future reporting cycles. These patterns suggest that observed differences in alignment may stem less from the availability of sustainability metrics and more from internal governance, market signalling strategies, or sector-specific conventions on materiality and accountability.

TABLE 3. Gap index statistics and related data across selected sectors

	Overall	Electric Utilities	Real Estate	Agrifood
Panel A: Descriptive Statistics				
Mean	0.60	0.69	0.57	0.58
Std	0.27	0.26	0.27	0.28
Min	0.00	0.00	0.00	0.00
Max	1.00	1.00	1.00	1.00
IQR	0.30	0.20	0.25	0.43
Skewness	-0.97	-1.85	-0.79	-0.74
Kurtosis	0.14	2.35	0.60	-0.29
Observations (firms)	392	78	196	118
Panel B: Data Associated				
No. of KPIs	3744	1174	1369	1201
Number of SLBs	177	54	63	60
Number of SLLs	520	117	263	140
Debt Amount (Billion USD)	378	142	132	104
ANOVA F-Statistic	11.82***			
Kruskal-Wallis H-Statistics	48.50***			

Notes: Panel A reports summary statistics for the Gap Index, including mean, standard deviation (Std), minimum (Min), maximum (Max), interquartile range (IQR), skewness, kurtosis, and the number of observations. Panel B summarizes the total counts of SLF and CARP SLF topics, as well as the number of Sustainability-Linked Bonds (SLBs) and Loans (SLLs), and total debt issued, expressed in billions of USD. The ANOVA F-statistic and Kruskal-Wallis H-statistic test for differences in the Gap Index across sectors. All figures assume data completeness; missing data are not imputed. Results are sector-specific and represent aggregated issuer-level data.

Temporal trends show a modest narrowing of the Gap Index across all sectors, but the pace and trajectory vary, hinting at different learning curves and levels of market readiness. In Real Estate, the steeper decline in the index may reflect greater maturity of certification schemes and a clearer translation pathway from risk assessments to loan covenants—especially in regions with strong regulatory support, as seen in Link REIT's integration of flood risk metrics in Hong Kong or Gecina's alignment with EU urban resilience goals. By contrast, the Electric Utilities sector remains relatively stable, possibly due to structural inertia in regulatory frameworks or the difficulty of embedding system-level adaptation KPIs into transactional instruments. Agrifood presents the most volatility, which may reflect the diversity of firm types, exposure to supply chain complexity, and the varying maturity of adaptation planning. For instance, while Bimbo has hard-wired water reuse metrics into recent loans, other issuers in the sector continue to frame resilience through broader sustainability narratives not yet

linked to financial consequences. These sectoral dynamics suggest that, although SLF markets are evolving, the integration of adaptation and resilience KPIs is still emerging—and shaped as much by institutional interpretation and market positioning as by technical capacity.

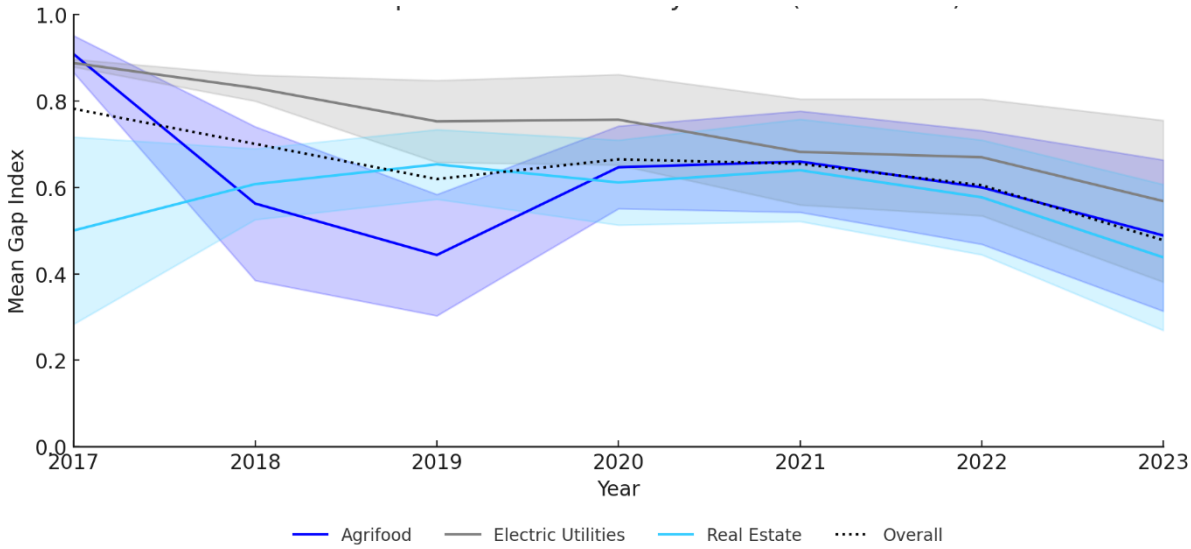


FIGURE 2. Temporal Trends in the Gap Index Mean Across Sectors

Notes: The plot figure the temporal trends in the Gap Index mean across different sectors, with 0.5 standard deviation bands shown for each sector's mean. The overall mean is depicted using a dotted line without a shaded area for clarity. The data points represent the mean values of the Gap Index for the first issuance year of SLF instruments across issuers.

Thematic decomposition of KPIs.— A thematic cut of the Gap Index shows a stark hierarchy in what firms are willing—or able—to hard-wire into their financing terms. Mitigation topics display the narrowest gap, suggesting that carbon-focused metrics are now sufficiently standardised and auditable to survive the leap from voluntary reports to step-up clauses. By contrast, the gap for pure adaptation KPIs verges on total mis-alignment: across almost 250 issuers the index hovers near unity, implying that references to flood-defence spending, drought tolerance or heat-stress mitigation remain almost entirely outside loan and bond covenants. Resilience and combined MAR themes sit in between, pointing to a gradual—though still limited—uptake of broader risk-management indicators such as GRESB scores or water-security ratios. Case evidence lends weight to this pattern: Enel and Iberdrola both run sophisticated physical-risk models, yet only Enel prices a taxonomy-aligned capex ratio and Iberdrola hard-wires a water-reuse target; Bimbo goes further by attaching an interest margin

to 100 % wastewater recovery, but most agrifood peers still leave similar metrics in narrative form. Together these observations suggest that the decisive hurdle is not data availability—the KPI inventories are large—but the absence of accepted verification protocols and a clear pricing narrative for adaptation outcomes.

TABLE 4. Mitigation, Adaptation and Resilience Gap Indexes' Statistics and Related Data

	Mitigation	Adaptation	Resilience	MAR
Panel A: Descriptive Statistics				
Mean	0.31	0.99	0.78	0.70
Std	0.38	0.07	0.35	0.36
Min	0.00	0.00	0.00	0.00
Max	1.00	1.00	1.00	1.00
IQR	0.66	0.00	0.33	0.50
Skewness	0.66	-13.28	-1.42	-0.87
Kurtosis	-1.11	174.50	0.50	-0.59
No. of Issuers/Borrowers	301	240	225	324
Panel B: Data Associated				
No. of KPIs	932	364	894	1361
Number of SLBs	161	84	126	143
Number of SLLs	390	275	288	448
Debt Amount (Billion USD)	327	170	267	332

ANOVA F-Statistic	337.96***
Kruskal-Wallis H-Statistics	695.25***

Notes: Panel A reports summary statistics for the Gap Index, including mean, standard deviation (Std), minimum (Min), maximum (Max), interquartile range (IQR), skewness, kurtosis, and the number of observations. Panel B summarizes the total counts of SLF and CSRs. SLF topics, as well as the number of Sustainability-Linked Bonds (SLBs) and Loans (SLLs), and total debt issued, expressed in billions of USD. The ANOVA F-statistic determine if there are statistically significant differences between the means of the gap indexes. Kruskal-Wallis H-statistic is a non-parametric test will assess whether there are statistically significant differences between the medians of the gap indexes. All figures assume data completeness; missing data are not imputed. Results are sector-specific and represent aggregated issuer-level data.

Figure 3 reinforces the asymmetry: mitigation shows a wide fan of outcomes—from instruments with almost no gap to those that still ignore emissions metrics—while adaptation collapses into a thin band at the top of the scale, underscoring its near-total exclusion. Resilience and MAR display long lower tails, hinting that a small but growing subset of deals is beginning to link financing costs to multi-hazard readiness. Qualitative insights suggest how this tail is forming. In Real Estate, Link REIT and Gecina channel flood-risk analytics and

biodiversity scores into loan covenants after pressure from regional lenders and rating agencies; in Agrifood, traceability and water-reuse clauses at COFCO and Bimbo reflect mounting supply-chain scrutiny from global buyers. These pockets of innovation highlight a possible transition path: once third-party benchmarks emerge and stakeholders coalesce around credible verification, previously "non-financeable" adaptation metrics can migrate into SLF structures. For now, however, the violin plots confirm that such breakthroughs remain the exception rather than the norm, leaving a material share of corporate climate-risk exposure unpriced.

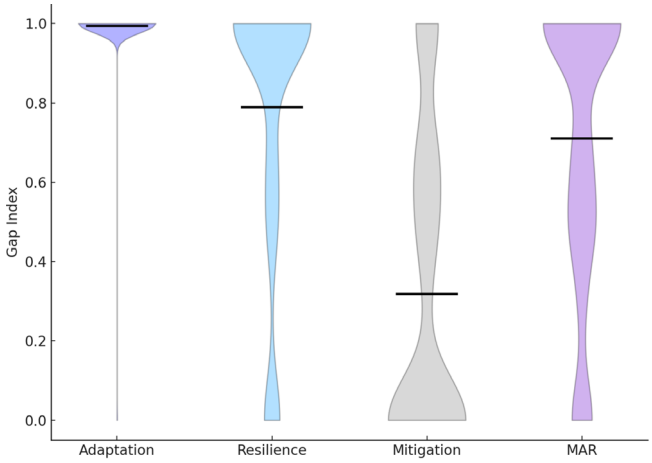


FIGURE 3. Temporal Trends in the Gap Index Mean Across Sectors

Notes: The plot figure the temporal trends in the Gap Index mean across different sectors, with 0.5 standard deviation bands shown for each sector's mean. The overall mean is depicted using a dotted line without a shaded area for clarity. The data points represent the mean values of the Gap Index for the first issuance year of SLF instruments across issuers.

Geographic patterns.— Contrary to expectations, the contractual uptake of resilience-related and MAR KPIs does not differ materially between developed and emerging issuers: mean Gap Indices cluster around 0.70–0.80 and neither ANOVA nor Kruskal–Wallis tests yield conventional significance. One plausible reading—echoed in the case material—is that the global banking syndicate model homogenises KPI templates across geographies. COFCO's loans, for example, were arranged by a club of European banks that applied essentially the same traceability metrics they use for OECD food majors, while Enel's Latin-American distribution subsidiaries finance themselves on terms drafted at corporate headquarters in

Rome. A second, more structural, possibility is that physical-risk data are still treated as supplementary disclosure rather than covenant-ready input almost everywhere. Iberdrola's detailed water-stress analytics in Spain and Bimbo's wastewater targets in Mexico show the technical feasibility of embedding resilience KPIs, yet each remains an outlier within its regional cohort. Finally, the heavier left-hand tails (skew < 0) for developed-market firms hint that a minority of early movers—often those with strong ESG index ambitions—are beginning to close the gap, whereas the broad inter-quartile ranges in both groups underline how far the bulk of issuers, north and south alike, still have to travel before adaptation and resilience metrics become standard pricing triggers.

TABLE 5. Adaptation and Resilience Gap Indexes' Statistics and Related Data between Firms from developed and emerging and other markets

	Developed Markets		Emerging & Other Markets	
	Resilience	MAR	Resilience	MAR
Panel A: Descriptive Statistics				
Mean	0.80	0.70	0.75	0.72
Std	0.34	0.34	0.38	0.39
Min	0.00	0.00	0.00	0.00
Max	1.00	1.00	1.00	1.00
IQR	0.33	0.50	0.41	0.50
Skewness	-1.51	-0.77	-1.25	-1.01
Kurtosis	0.84	-0.60	-0.10	-0.60
Observations (firms)	141	180	86	146
Panel B: Data Associated				
No. of KPIs	694	864	245	467
Number of SLBs	88	96	38	47
Number of SLLs	195	280	93	168
Debt Amount (Billion USD)	202	233	65	98
ANOVA F-Statistic	Resilience: 1.363		MAR: 0.566	
Kruskal-Wallis H-Statistics	Resilience: 1.017		MAR: 3.129	

Notes: Panel A reports summary statistics for the Gap Index, including mean, standard deviation (Std), minimum (Min), maximum (Max), interquartile range (IQR), skewness, kurtosis, and the number of observations. Panel B summarizes the total counts of SLF and CARP SLF topics, as well as the number of Sustainability-Linked Bonds (SLBs) and Loans (SLLs), and total debt issued, expressed in billions of USD. The ANOVA F-statistic determine if there are statistically significant differences between the means of the gap indexes. Kruskal-Wallis H-statistic is a non-parametric test will assess whether there are statistically significant differences between the medians of the gap indexes. All figures assume data completeness; missing data are not imputed. Results are sector-specific and represent aggregated issuer-level data.

Among the 1 135 contract-level KPIs we catalogued, only 225 (~ 20 %) fall under a resilience heading; yet even this small subset is revealing. Heat-map decomposition (Figure 4) shows that issuers gravitate toward a narrow band of topics with readily auditable, "inside-the-fence" data. In developed markets, four themes dominate: employee health & safety (18 % of all resilience KPIs), customer welfare (8 %), waste & hazardous-material management (6 %) and water management (6 %). Each is overwhelmingly framed with a numeric target and a dated baseline (≥ 95 % coverage), signalling that once a company chooses an operational-risk indicator it is comfortable translating it into covenant language. By contrast, forward-looking or systemic levers—systemic-risk management, critical-incident risk and business-model resilience—appear only a handful of times. The pattern is even starker in emerging and other markets: supply-chain impacts & ingredient sourcing account for 23 % of all resilience KPIs, reflecting pressure from global buyers for deforestation-free and socially responsible inputs (an approach illustrated by COFCO's soy-traceability loan), while most facility-centred metrics remain scarce.

Two broader insights emerge. First, resilience is being operationalised through occupational-safety, customer-protection and traceability indicators rather than through direct measurement of climate-hazard exposure. Case studies reinforce this reading: Link REIT embeds GRESB's "community connectivity" sub-score rather than explicit flood-loss metrics, and Bimbo prices water-reuse rates but not watershed-level stress indices. Second, the high prevalence of targets and baselines once a metric is chosen suggests that adaptation reporting is not the bottleneck; the hurdle is selecting which resilience dimensions investors are willing to price. As verification protocols mature—for example, biodiversity-linked KPIs under EU CSRD or TNFD guidance (EFRAG, 2022; Mair et al., 2024)—the next logical expansion beyond mitigation would be to hard-wire these broader nature- and supply-chain-risk metrics, as outlined in our previous work, Resendiz et al. 2025. In short, the data point to a ready-made on-ramp for issuers: leverage the existing discipline around target-setting and baselining, but shift the content of KPIs from plant-level process indicators toward systemic resilience and nature-related dependencies.

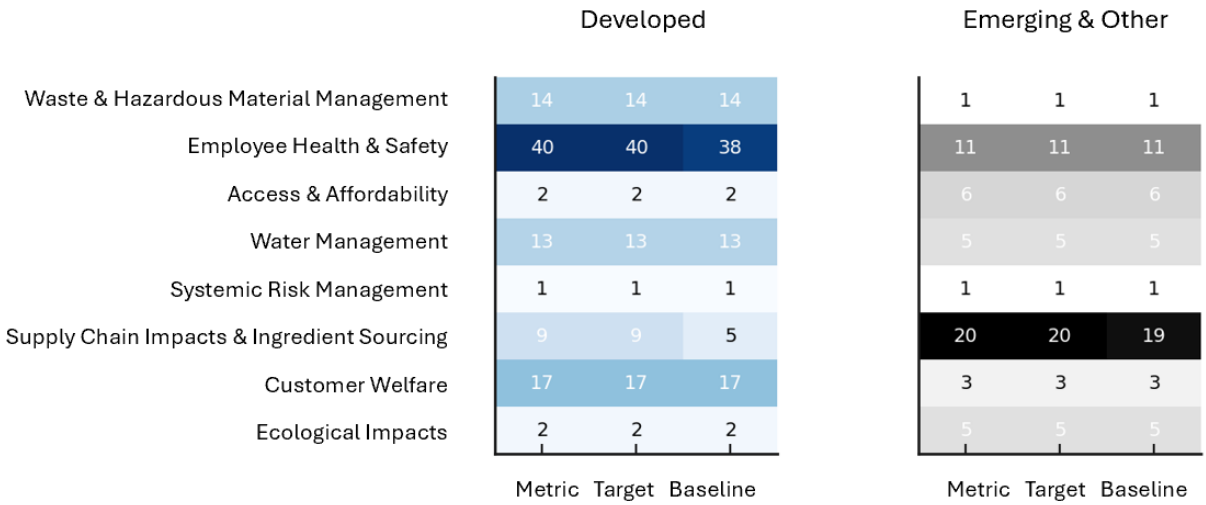


FIGURE 4. Attribute coverage of resilience KPIs in SLF instruments across developed and other markets

IV. Discussion

A. Adaptation-linked finance and input–output KPIs.—The findings reveal that only a small fraction of the KPIs in SLF instruments address adaptation or enterprise resilience. The Gap Index for these themes approaches one. This scarcity reflects both a conceptual gap and a measurement challenge. Unlike emissions mitigation, for which there is a widely accepted unit of account, A&R involves a heterogeneous array of activities tailored to local climate risks. Estimating adaptation finance needs is challenging due to context-specific risks and responses, while existing tracking methods tend to classify finance rather than measure adaptation processes or outcomes (Larsen et al., 2025). The academic literature on corporate adaptation highlights that firms adjust leverage structures, increase cash holdings and reconfigure supply chains to mitigate physical risks (Hennes et al., 2024), yet very few studies examine how such actions are operationalised or monitored. These insights suggest that focusing SLF exclusively on outcomes is insufficient. To mobilise investment in resilience, covenant design should reward robust processes along the adaptation value chain: input metrics such as the share of capital allocated to risk assessments or early-warning systems; activity metrics such as the

number of suppliers audited for flood risk or the proportion of facilities with emergency plans; and output metrics such as the reduction in downtime after extreme events. Because once a KPI is selected firms tend to specify a baseline and target, as shown by the high prevalence of measurable targets in our dataset, linking interest-rate step-ups and step-downs to these process indicators could provide transparent, verifiable signals without requiring a single universal outcome metric. Such a shift would align finance with the iterative nature of adaptation and encourage firms to embed climate-risk management into their operational routines.

B. Aligning Corporate A&R Plans and SLF.—Our evidence suggests that a Corporate Adaptation and Resilience Plan, including as part of an overall transition plan, gains most traction when its core levers (risk targets, capital budgeting, governance routines and stakeholder incentives) are mirrored in a linked-finance structure. Recent guidance from the NGFS recommends embedding adaptation within transition plans across five pillars and, crucially, using a maturity pathway for metrics and targets that moves from baseline exposure to inputs and then outcome- or risk-based outputs; this provides a ready template for calibrating SLF KPIs and ratchets (NGFS, 2025). An SLF facility can hard-wire the plan's headline risk metrics into pricing terms, so every quarterly draw-down or coupon payment becomes a rolling test of progress; Link REIT's flood-readiness margin grid and Gecina's heat-wave and biodiversity score triggers illustrate the effect (Link REIT, 2022; Gecina, 2023). Because coupon ratchets convert resilience spending into an immediate cost-of-capital signal, treasury teams suddenly have a cash-flow reason to prioritise the capex earmarked in the plan—exactly what Enel achieved by tying grid-hardening expenditure to its bond spread (Enel, 2022). Third-party verification clauses, now standard under ISO 14090 and the TCFD's metrics-and-targets guidance, lift the same data flows straight into the board-risk dashboard, closing the governance loop (ISO, 2019; TCFD, 2021). Finally, SLF covenants can cascade the plan beyond the corporate fence: Bimbo's wastewater-reuse KPI sets a price incentive that reaches into supplier practice, while COFCO's traceability targets mobilise growers and traders along the soy and palm chains (Bimbo, 2023; COFCO, 2022). In short, the synergy works both ways: the plan gives lenders a clear performance map, and the SLF turns that map into enforceable, financeable milestones aligned with an NGFS-consistent hierarchy of metrics, targets and engagement.

C. Enabling A&R-linked SLF through financial policy.— From our analysis we can infer that the gap between what firms disclose on A&R and what they embed in SLF contracts stems not from data scarcity but from weak infrastructure, few verification norms and unclear incentives. To address this, financial regulators and ministries of finance can catalyse market development through voluntary, low-burden measures that align with existing reporting practice. First, pilot schemes should encourage issuers to hard-wire a small number of process-based A&R KPIs already disclosed in sustainability reports into pricing terms, using a progressive pathway from inputs and activities to outputs and outcomes; a supervisory note could offer template clauses, safe-harbour verification standards and a flexible compliance track aligned with international standards (e.g., IFRS, 2023; ISO, 2022). Second, regulators and public financiers should recognise risk-transfer and liquidity arrangements such as drought insurance, catastrophe cover and undrawn credit lines as eligible KPIs, reflecting their quality in guarantee pricing and fiscal incentives; for example, an agrifood borrower could earn a 5–10 bp step-down by maintaining parametric drought insurance that covers at least half of seasonal input costs or by holding an undrawn liquidity line sized to roughly one quarter of quarterly operating expenses. Third, ministries of finance can support market formation by funding public goods: an open KPI library with ready-to-use baselines and calculators, hazard and exposure datasets tailored for SME use, and a voluntary registry of SLF targets and outcomes to lower verification costs. The KPI library should be cross-referenced to the country's National Adaptation Plan (NAP) (and National Biodiversity Strategies and Action Plans, NBSAPs, for the case of biodiversity KPIs, Resendiz et al. 2025) so firm-level indicators ladder up to national priorities and monitoring frameworks. These low-friction interventions do not require major legal reform or supervisory overhaul, yet they can directly reduce transaction costs, improve price signalling and close the gap between narrative disclosure and enforceable adaptation action. We also note the synergies and cross-overs between A&R and biodiversity KPIs, which suggests benefits of taking an integrated approach.

IV. Conclusion

This study provides the first comprehensive mapping of how A&R metrics are embedded or omitted in SLF instruments, building upon previous work on biodiversity and SLF (Resendiz et al. 2025). By introducing the Gap Index and analysing over 2,600 disclosed KPIs across key sectors, we quantify a persistent misalignment between what firms report and what they are held financially accountable for. Our findings demonstrate that SLF holds significant untapped potential to integrate climate resilience into corporate finance, provided that standardisation and verification frameworks are further developed. One limitation is the exclusion of financial corporations as issuers or borrowers, which may follow distinct incentive structures. In addition, while small and medium enterprises (SMEs) are currently absent from SLF markets, future research should examine how SLF structures can be adapted to their specific needs, given their heightened exposure to climate risks. Further work on issuer benchmarking and the evolving role of capital providers will also be essential to scale A&R-linked finance effectively.

APPENDICES

Appendix A. Retrieval Augmented Generation for KPIs Extraction and Classification

This technical appendix details the implementation of a Retrieval Augmented Generation (RAG) approach to identify and extract nature-related KPIs from a structured PDF document. The method combines the strengths of retrieval-based techniques with generative models to improve the relevance and accuracy of the generated outputs. The implementation leverages several Python libraries, including `langchain`, `PyPDF2`, `FAISS`, and `pandas`, to process the data, perform retrieval, and generate contextually accurate responses. Additionally, we classify the extracted metrics according to the Sustainability Accounting Standards Board (SASB) standards.

Data Preparation. — The first step in implementing a RAG model is to prepare the data that will serve as the knowledge base for retrieval. This data is typically unstructured text that needs to be processed and segmented into manageable chunks, which can then be searched efficiently. In our implementation, we start by loading an Excel file containing a list of sample metrics, which are later used to enhance the query. Additionally, we load a PDF document containing the target information. The text is extracted from the PDF using the `PdfReader` class from the `PyPDF2` library. To handle the token size constraints of language models, the extracted text is split into smaller, overlapping chunks using the `CharacterTextSplitter` class from the `langchain` library. This ensures that each chunk is sufficiently small for processing while maintaining contextual overlap for improved relevance during retrieval.

Embeddings and Vector Store. — Embeddings are numerical representations of text that capture semantic meaning in a vector space. These embeddings enable the retrieval system to find semantically similar text chunks based on the input query. A vector store, such as `FAISS` (Facebook AI Similarity Search), is used to store and efficiently search through these embeddings. We use the `OpenAIEmbeddings` class to convert each chunk of text into a high-dimensional vector. These vectors are then stored in a `FAISS` index, which supports fast and efficient similarity searches. The `FAISS` index allows the system to quickly retrieve the most relevant text chunks in response to a query.

Query Augmentation. —Query augmentation involves enhancing the initial user query with additional relevant information. This step improves the precision of the retrieval process by making the query more specific and contextually rich. In our case, the query is augmented with a list of sample metrics extracted from the Excel file. These metrics are converted into a string and incorporated into the query, ensuring that the retrieval system focuses on finding text chunks that are specifically related to these metrics.

Retrieval Step. —The retrieval step involves searching the vector store for text chunks that are most similar to the augmented query. The aim is to identify the most relevant pieces of text that contain the information needed to answer the query. Using the `similarity_search` method from the `FAISS` vector store, we retrieve the top text chunks that are most similar to the augmented query. These chunks are then passed to the next stage for further processing and response generation.

Generation Step. —After retrieving relevant documents, the generative model synthesizes this information to produce a coherent and contextually accurate response. The model is guided by the retrieved documents, allowing it to generate text that is both relevant and informative. We use the `load_qa_chain` method from the `langchain` library to load a pre-configured question-answering chain. This chain leverages the retrieved text chunks as input to an OpenAI language model, which then generates the final output in response to the query.

Classification. —Once the KPIs related to sustainability metrics are extracted, they need to be categorised according to recognised standards. The SASB provides an industry-specific categorization framework based on financial materiality (IFRS, 2023), which is widely used in sustainability reporting. This classification ensures that the extracted metrics are aligned with industry standards and can be properly contextualized within financial reports. To classify the extracted KPIs according to SASB standards, we utilise a pre-existing spreadsheet that contains mappings of metrics to their corresponding SASB categories. After the extraction process, we cross-reference the extracted metrics with this spreadsheet to assign each metric to its appropriate SASB category.

Appendix C. Framework for the Selection of Case Studies

Case studies were analysed based on a framework comprised of three criteria: the SLF deal overview, its metrics and targets analysis, and risks, opportunities and challenges related to its further integration of A&R. This analytical framework is based on the insights, guidelines, and recommendations to address climate-related debt markets provided by IRIS Five Dimensions of Impact (2020), CBI's Climate Resilience Principles (2019), ICMA's Climate Transition Finance Handbook (2023) and LMA's Sustainability-linked Loan Principles (2023). As shown in the table below, each criterion covers different subtopics and is related to different sections developed through the case study analysis of the selected companies.

Table B1. Criteria for analysing case studies

	Criteria	Sections
Overview	*Deal Overview*	Deal overview in relation to A&R aspects of the CSR.
	Financial structure	Description of the SLF deal (e.g., issuer, financing structure, KPIs, and sustainability goals).
	Alignment with CSR	Analyse the deal's alignment with the issuer's A&R strategies outlined in CSRs, including how the deal supports the issuer's broader A&R goals and priorities (ICMA, LMA).
	Reputation	Assess the issuer's sustainability performance and reputation, including any previous sustainability initiatives and awards or recognition received. (ICMA).
Metrics	*KPI Quality*	Evaluate the quality and relevance of the KPIs selected for the sustainability-linked financing deal, including their specificity, measurability, achievability, and time-bound nature. (IRIS, LMA, ICMA).
	Progress towards goals	Analyse the issuer's progress towards achieving the KPIs and the broader sustainability goals in the financing deal. (IRIS, LMA).
	Impact	Evaluate the effectiveness of the sustainability-linked financing deal in achieving climate A&R in the real economy. (IRIS, CBI).
A&R Alignment	*Integration of A&R*	Further Integration of A&R: Risks, Opportunities, and Challenges.
	Climate risk awareness	Identify the risks, opportunities, and challenges associated with further integrating climate A&R metrics and targets into the issuer's sustainability strategy and financing activities. (IRIS).
	Stakeholder engagement	Assess the stakeholder engagement and buy-in level necessary to successfully integrate climate A&R metrics and targets into the issuer's sustainability strategy and financing activities (IRIS).
	Opportunities and challenges	Analyse the opportunities and challenges of further integrating climate adaptation and resilience metrics and targets into the issuer's sustainability strategy and financing activities. (CBI).

Source: Authors' framework.

Appendix C. Analysis of Case Studies

Case Study A: Link REIT. — Link REIT, a leading Hong Kong real estate investment trust, offers a valuable case study in understanding the potential of SLF to support A&R objectives through industry-standard climate risk indicators. This case study highlights Link REIT's corporate alignment with A&R outcomes through sustainability targets that go beyond their enterprise value, achieved via collaboration with regional A&R strategies, including DFIs and financial institutions. Their strategic lending relationship with state-owned Chinese banks underscores their engagement strategy, while the connection between their financing framework and CSR enhances their commitment to climate resilience. Moreover, we found a significant gap between KPIs included in its CSCR and SLF structures, which brings the opportunity to have more specific KPIs related to A&R outcomes, such as the percentage of portfolio assets covered by climate resilience strategies.

We focus on Link REIT's approach to assessing potential coastal flooding impacts on their Greater Bay Area (GBA) properties, offering insights for integrating better KPIs in future transactions. In summary, Link REIT's USD 12.5 billion debt issued through seven SLLs from 2020 to 2022 serves as an industry benchmark, emphasizing the interdependence between sustainable finance and climate resilience, showcasing the importance of aligning financial strategies with sustainability goals while maintaining transparency and accountability. See further details of our assessment in Table 9 and the entity's SLF framework in Table 10.

TABLE C1. Link REIT's SLF Assessment

Assessment Criteria	Key findings
Incorporation of A&R indicators	Link REIT includes industry-standard indicators in its SLF framework, such as green building certifications that incentivize resource use efficiency and enhance occupant health and overall community connectivity (Champagne & Aktas, 2016). Their SLLs also include the GRESB score, which covers entities' resilience strategy to climate-related risks, the use of scenario analysis, asset-level risk assessments during the last three years, and the firm's community engagement programs in terms of resilience (including assistance or support in case of disaster).
Establishment of indicators through a risk assessment process	Link REIT (2022) reported conducting risk assessments for flooding caused by rainstorms, typhoons, and rising sea levels. These assessments identified potential financial implications such as reduced revenue, increased costs, and higher capital costs. Link REIT details the implementation of A&R measures, including a preparedness protocol (drain clearance, flood barriers, signage securing, access control), Internet of Things flood adaptation solutions for properties, and geospatial risk analysis for coastal assets in the Greater Bay Area.

Alignment with long-term A&R objectives	SLF indicators align with the entity's CSR long-term actions, focusing on disaster policies, asset-level risk assessments related to natural hazards, projects addressing building safety, and a systematic process for identifying climate-related physical risks.
Consideration of social and environmental safeguards	Link REIT reports examples of engagement with investors and regional-level policymakers to develop climate resilience strategies. Third-party reviewers have examined this strategy's social and environmental impacts, evaluating its benefits and financial value, including job creation.
Enhancing resilience beyond enterprise value	Link REIT's physical climate risk assessments serve the financial sector in four ways to enhance resilience beyond the enterprise value. First, it supports investors in identifying vulnerabilities and estimating what is required to invest to improve resilience (GIZ, 2021). Second, it informs clients when making investing decisions. Third, they serve as a tool for determining the choice of building materials and the structure of properties (Attoh et al., 2022). And lastly, they assist firms in the development of feasible A&R strategies.

Link REIT's efforts to address physical climate risks underscore the advantages of public-private collaboration. As noted in a report by their sustainability advisor (ULI, 2022), HSBC, the real estate sector in the GBA faces climate risks like storms, flooding, sea-level rise, extreme heat, and drought. Failure to manage these risks may lead to increased damage claims, loan defaults, and decreased property values. The report emphasizes cooperation between the public and private sectors to address these challenges to assess risks, develop infrastructure, implement policies, and ensure long-term resilience and sustainability in the industry. This information aids in evaluating vulnerabilities and creating plans to mitigate coastal risks in the GBA real estate sector.

TABLE C2. Link REIT's SLF Framework Summary

SLF Instruments	7 SLLs*	*Total issuance*	USD 12.5 billion
Country of issuance	Hong Kong	*Period of issuance*	2020-2022
Stakeholders	Syndicated group of banks: Bank of China, DBS Bank, Industrial and Commercial Bank of China, Oversea-Chinese Banking Corporation, Bank of America, Bank of Communications, CMB Wing Lung Bank, and HSBC. Sustainability Advisor: HSBC Verifiers: HKQAA, S&P Global and Science Based Targets Initiative (SBTi)		
*Financial structure***	Credit facilities (pre-approved line of credit)		
Issuer's reputation	Between 2021 and 2022, Link REIT excelled in ESG performance, marked by a decade-long "Green Star" GRESB rating, top evaluations from MSCI and S&P, inclusion in prestigious indices like Dow Jones and FTSE4Good, and a "Low Risk" classification by Sustainalytics. These underscore our unwavering commitment to sustainability and ethical business. Link REIT has also successfully issued $1B in green bonds, channeling the proceeds into energy, water, and eco-friendly building projects.		

	Mitigation KPI • GHG emissions reduction: 25% reduction in carbon emissions intensity (Scope 1 & 2) across our portfolio by 2025/2026 (compared to the 2018/2019 baseline). Net Zero carbon emissions (Scope 1 & 2) by 2035. Set SBTi-approved net zero carbon emissions targets (Scope 1, 2 & 3) by 2024/2025. 100% renewable energy adoption across our portfolio by 2035
KPIs in the SLF Framework	*Mitigation, Adaptation and Resilience (MAR) KPIs* • GRESB Score: The A&R-related indicators cover entities' resilience strategy to climate-related risks, scenario analysis, asset-level risk assessments during the last three years, and entities' community engagement programs regarding resilience (including assistance or support in disaster). • Engaging contractors: green building certification coverage across the portfolio (%) – 100% by 2026. Tenant engagement: Percentage of green lease adoption in Hong Kong and Mainland China by 2027 – 50%.
KPIs in the CARP *A&R KPIs from CARP, which are not present in the SLF framework, suggest potential future transaction metrics.*	Assess Climate Risk and Develop Resilience Strategies: • Annual amount of conducted climate risk assessments. • Percentage of portfolio assets assessed for climate risk. • Number of developed climate resilience strategies. • Percentage of portfolio assets encompassed by resilience strategies. Collaborate with Investors and policymakers: • Number of engagements with investors focusing on climate resilience. • Number of regional policymakers involved in climate resilience dialogues. • Number of strategies co-developed with investors and policymakers. • Number of partnerships established for climate resilience initiatives.

Sources: Link REIT (2022), Environmental Finance (2023), and Bloomberg (2023).
Note: (**) Private loans do not have a global, public identifier like ISINs. Identification is typically managed through internal systems and agreements specific to the parties involved in the loan transaction. We retrieved this data from Environmental Finance (2023). (*) Syndicated loan markets pose challenges in accessing detailed financial structure information due to their private nature, diverse lender base, and limited regulatory oversight. Unlike the more transparent and standardized bond market, syndicated loans often feature heterogeneous terms tailored to borrower and lender preferences, resulting in limited public disclosure and secondary market liquidity.

Case Study B: Gecina. — By asset valuation, Gecina, Europe's largest office real estate firm, featured a portfolio valued at EUR 18.5 billion as of June 2023 (Gecina, 2023). We identified that their SLF aligns with their CSR in assessing and managing physical climate risks. Gecina employs sector-specific ratings in this context, integrating the A&R metrics from their CSR. This case study focuses on Gecina's efforts to improve urban architecture and renovation in Paris, which has the most extensive private residential portfolio. Our analysis underscores Gecina's strategic application of sector-specific scoring to the real estate industry, integrating A&R metrics related to flooding, heatwave risks, and biodiversity conservation. As a result, Gecina stands as Europe's leading office real estate company, ranked prominently in the GRESB and holding the second-largest global position in the Dow Jones Sustainability Indices (DJSI).

Gecina's SLF framework (Table 12), involving four SLLs totaling USD 1.29 billion in the French market from 2018 to 2019, ties credit facilities to Gecina's sustainability performance, notably carbon intensity per square meter of operational space. It also incorporates MAR-related KPIs, such as GRESB and BREEAM Scores, WELL Building Standard adherence, and a biodiversity policy. Gecina's reputation stems from an 'A' ranking in the Carbon Disclosure Project and a remarkable 94 out of 100 GRESB rating, underpinned by its zero-emission plan and ongoing sustainability efforts encompassing emissions reduction, energy efficiency, green space expansion, and construction material reuse.

TABLE C3. Gecina SLF Framework Assessment

Assessment criteria	Key findings
Incorporation of A&R indicators	Gecina's SLF incorporates GRESB and BREEAM metrics to track performance on flood risk management, heatwave risk mitigation, and biodiversity preservation. GRESB indicators focus on resilience strategy and risk assessments, while BREEAM emphasizes green spaces and wildlife habitats (BRE Group, 2022; GRESB, 2023).
Establishment of indicators through a risk assessment process	Gecina identifies hazards using EU taxonomy and customizes intensity measures for each asset's location. They have found that 97% of their portfolio in Paris is prone to flooding, with 33% having a gross risk. Additionally, 3.7% of the operating portfolio's surface area is exposed to heat waves for over 30 days annually (DRIEAT, 2023a; Gecina, 2022).
Alignment with long-term A&R objectives	Gecina's CARP aligns with Paris' flood and heatwave mitigation strategies until 2050. Backed by in-depth analysis and government data, Gecina has tailored action plans and adaptation measures like cofferdams and non-return valves. Their data-driven, policy-aligned approach underscores a proactive stance in long-term risk management (DRIEAT, 2023b).
Consideration of social and environmental safeguards	Emphasizing social safeguards, Gecina's Living Well Policy and WELL certification underscore their commitment to quality indoor spaces, safeguarding occupant safety during flood and heatwave events. Their focus on air, lighting, and acoustic quality is instrumental in mitigating health risks associated with such climate adversities.
Enhancing resilience beyond enterprise value	Gecina addresses the Urban Heat Island effect in Paris through nature-based solutions like expanding urban greenery. They have developed 400,000 m2 of green surfaces on buildings. The third-party evaluation indicated that 62% of Gecina's assets significantly impact the green network, and 19% enhance the blue network, underscoring their broader environmental contribution (Cerema, 2020; Gecina, 2014; Hou et al., 2023; Xi et al., 2023),

While Gecina's SLF incorporates A&R indicators like GRESB and BREEAM, its reliance on third-party assessments may lack precision. Moreover, long-term A&R objectives could present challenges regarding flexibility and adaptability. Additionally, Gecina's focus on mitigating the Urban Heat Island (UHI) effect in Paris is a creditable effort. However, the success of these nature-based solutions and green space expansions in countering heat islands

is contingent on various factors, including maintenance, urban planning, and local climate conditions. Ensuring these initiatives achieve their intended impact and not inadvertently introduce new ecological challenges will require ongoing monitoring and adaptation.

TABLE C4. Gecina's SLF Framework Summary

*SLF Instruments**	4 SLLs	*Total issuance*	USD 1.29 billion
Market of issuance	France	*Period of issuance*	2018-2019
Stakeholders	Syndicated group of banks: BNP Paribas, Natixis, Société Générale, ING France, Crédit Agricole Corporate & Investment Bank (CACIB) Sustainability Advisor: CACIB Verifiers: ISS ESG		
*Financial structure***	Credit facilities (pre-approved line of credit)		
Issuer's reputation	Gecina, achieving an A rating in the Carbon Disclosure Project and scoring 94/100 in the GRESB, credits its success to robust corporate social responsibility goals and its ambitious 2030 zero-emission strategy. Emission reduction, enhanced energy efficiency, green space expansion, and construction material reuse initiatives are central to Gecina's efforts.		
KPIs in the SLF Framework	*Mitigation KPIs* • Carbon intensity of the portfolio of buildings in operation in $kgCO_2/m2/yr$		
	Mitigation, Adaptation and Resilience (MAR) KPIs • Global Real Estate Sustainability Benchmark (GRESB) rating score: The A&R-related indicators encompass entities' resilience strategy to climate-related risks, scenario analysis, and asset-level risk assessments during the last three years. • BREEAM Score: The A&R- related indicators cover the entities' incorporation of green spaces, wildlife habitats, and green roofs. • Percentage of new buildings with WELL Building Standard		
KPIs in the CSR *A&R KPIs from CSR, which are not present in the SLF framework, suggest potential future transaction metrics.*	Exposure to climate hazards. • Percentage of the portfolio's surface area exposed to flooding risk. • Percentage of the portfolio's surface area exposed to more than 30 days of heatwave per year. Biodiversity policy. • Square meters of green surface area on buildings in operation. • Surface areas awarded with the BiodiverCity label. • The number of habitats created in assets for local species. • Percentage of assets that contribute to Paris' green ecological continuity. • Percentage of operational staff trained in biodiversity. • Percentage of buildings with a green space applying the green space ecological management policy.		

Sources: Gecina (2022), Environmental Finance (2023), and Bloomberg (2023).

Note: (*) Private loans do not have a global, public identifier like ISINs. Identification is typically managed through internal systems and agreements specific to the parties involved in the loan transaction. We retrieved this data from Environmental Finance (2023). (**) Syndicated loan markets pose challenges in accessing detailed financial structure information due to their private nature, diverse lender base, and limited regulatory oversight. Unlike the more transparent and standardised bond market, syndicated loans often feature heterogeneous terms tailored to borrower and lender preferences, resulting in limited public disclosure and secondary market liquidity.

Case Study C: Bimbo. — Bimbo has been playing a leading role in advocating for more sustainable food systems at the global level. As one of the world's largest bakery companies, their SLF framework and CARP focus on financing wastewater management in low and upper-middle-income countries. We argue that Bimbo's initiatives serve as a benchmark for the agrifood industry and offer valuable insights into integrating A&R metrics into future transactions. Climate change challenges, including the strain on land and water resources leading to reduced yield growth, compound the pressure on food production systems to satisfy the increasing demands of a growing global population (Trudinger et al., 2023). Bimbo's case study offers valuable lessons regarding innovative approaches to delivering A&R outcomes, such as responsible water management measures contributing to resilience in food supply chains.

According to Bimbo's SLF framework (Table 14), the company has issued 4 SLLs and 1 SLB, amounting to a total issuance of USD 3.9 billion (SLLs) and USD 851 million (SLB) between 2021 and 2023 in the Mexican market. This initiative, backed by a syndicate of banks including BBVA, HSBC, and Santander and advised by Cleary Gottlieb, has transformed their previous credit facility into a sustainable one. Bimbo's SLF structure aims to optimize water usage by reducing consumption, treating, and reusing water. Bimbo's KPI is committed to increasing the reuse of treated water to 100% by 2025. This will be achieved by reducing conventional water supplies and improving wastewater treatment technology, such as implementing water circuits.

TABLE C5. Bimbo's SLF Framework Assessment

Assessment criteria	Key findings
Incorporation of A&R indicators	The agrifood industry is the primary freshwater consumer (Mekonnen & Gerbens-Leenes, 2020). As a result, Bimbo integrates A&R indicators within its SLF framework to address water scarcity, amplified by climate change, threatening food security and public health. They reported achieving a 92.5% of water reuse in 2022 through upgrading water treatment plants and high-tech loops (Bimbo, 2022). Cases like Israel's effective water reuse in agriculture validate this approach (Sapkota, 2019).
Establishment of indicators through a risk assessment process	Bimbo's risk assessment relies on regenerative agriculture, assessed using GRI & SASB standards. Their TCFD reports focus on physical climate risks, particularly water use metrics for machinery and bakery services (Bimbo, 2023). Regenerative agriculture benefits water conservation, quality, biodiversity, productivity (CC, 2023), and farmer well-being (Brown et al., 2022). This approach is a vital adaptation strategy for climate extremes and local food security (Mpanga et al., 2021).
Alignment with long-term A&R objectives	Bimbo's sustainability strategy is intertwined with regenerative agriculture, to cultivate 200,000 hectares of wheat using these practices by 2030. By 2050, Bimbo aspires for

	100% of its key ingredients to be produced through regenerative agriculture, and by 2025, all water treated in services outside of processes will be reused, benchmarking the 2020 baseline (Bimbo, 2023).
Consideration of social and environmental safeguards	Wastewater management in Bimbo is integral for public health and environmental protection. Beyond compliance, it fosters trust within communities. Preventing contamination and disease outbreaks mitigates financial and legal risks and positions the company as a sustainable leader amidst evolving consumer and investor expectations.
Enhancing resilience beyond enterprise value	Bimbo's sustainable water practices emphasize broader environmental and social implications, transcending immediate financial gains. The company reports bolstering supplier resilience, especially for small-scale farmers, by promoting efficient irrigation and conservation in the face of climate change and increasing water stress (Mekonnen & Gerbens-Leenes, 2020).

Bimbo's SLF framework poses inherent risks and challenges, particularly in executing ambitious goals such as achieving 100% water reuse by 2025 and implementing advanced water treatment technology. The success may be influenced by market and economic uncertainties, and the company does not provide precise financial planning that supports such commitment. Additionally, the unpredictability of climate change and complexities within the supply chain introduces additional risks that are not addressed in the framework. Bimbo's CARP offers a broader range of actions in this regard, which could be integrated into future SLF transactions to bolster the credibility of its strategy.

TABLE C5. Bimbo's SLF Framework Summary

Instruments	4 SLLs and 1 SLB	*Total issuance*	USD 3.9 billion (SLL) USD 850 million (SLB)
Market of issuance	Mexico	*Period of issuance*	2021-2023
Stakeholders	Syndicated group of banks: BBVA, HSBC, Santander Sustainability Advisor: Cleary Gottlieb Verifiers: Sustainalytics		
*Financial structure**	Credit facilities (pre-approved line of credit). SLB was issued in two series: The first series, totaling around USD 680 million, had a 10-year maturity with a fixed annual rate of 9.24%. The second series, around USD 170 million, had a three-year maturity with an annual floating rate of 28-day TIIE +0.10%. The press release did not disclose the step coupon margin.		
Issuer's reputation	Bimbo is the first Mexican food company committed to achieving emissions neutrality by 2050. Their top ranking further highlights their dedication to sustainability in "The 100 Companies with the best Social Responsibility and Governance in Mexico."		
KPIs in the SLF Framework	*Mitigation KPIs* • Reduction in absolute GHG emissions (Scope 1: CO_2 Ton /CO2 and Scope 3: CO2 Ton /CO2) • Percentage of renewable energy in the energy mix (Scope 2: Total kWh renewables/Total kWh consumption		

	Mitigation, Adaptation and Resilience (MAR) KPIs • Percentage of treated water reused (Total volume m3 of treated and reused water/ Total volume m3 of treated water)
KPIs in the CARP *A&R KPIs from CARP, which are not present in the SLF framework, suggest potential future transaction metrics.*	Sustainable Management of Living Natural Resources and Land use. • Percentage of critical ingredients produced with regenerative farming practices. • The number of hectares with regenerative agriculture practices. • The number of farmers trained in regenerative agriculture. • The number of hectares of natural landscapes preserved and restored. • Percentage or volume of procurement of raw materials certified by environmental or ethical certification organizations. • Total treated water (m3). • Total reused water (m3). • Cubic meters of reused treated wastewater from total treated wastewater.

Sources: Bimbo (2022), Environmental Finance (2023), and Bloomberg (2023).

Notes: (*) Private loans do not have a global, public identifier like ISINs. Identification is typically managed through internal systems and agreements specific to the parties involved in the loan transaction. We retrieved this data from Environmental Finance (2023). (*) Syndicated loan markets pose challenges in accessing detailed financial structure information due to their private nature, diverse lender base, and limited regulatory oversight. Unlike the more transparent and standardized bond market, syndicated loans often feature heterogeneous terms tailored to borrower and lender preferences, resulting in limited public disclosure and secondary market liquidity.

Case Study D: COFCO. — COFCO (China Oil and Foodstuffs Corporation) is a Chinese state-owned food processing holding company and the largest food processor, manufacturer and trader in China, operating in over 140 countries (COFCO, 2020). COFCO's climate strategy mainly focuses on mitigation (target to reduce GHG emissions by 50% by 2030) and resilient supply chains. It is worth noting that their SLF framework has focused on the latter aspect, especially regarding the supply chain traceability of agricultural products. Such an approach mitigates deforestation and strengthens agriculture's ability to withstand climate risks. Also, it contributes to preventing habitat loss, conserving biodiversity, countering forest fragmentation, and regulating regional climate, as climate change and forest depletion disrupt weather patterns (Ayompe et al., 2021; IPCC, 2021). Furthermore, these measures contribute to averting higher temperatures, prolonged dry seasons, soil erosion, and water scarcity (Meubeck et al., 2021). COFCO's case study showcases a positively aligned framework that addresses A&R issues through sustainable supply chain management.

As depicted in Table 16, COFCO's SLF framework encompasses three SLLs of 4.4 billion USD issued between 2019 and 2022. These loans were collaboratively set by a syndicate group of banks, including BBVA, BOC, Natixis, and ING. Among these partners, BBVA acted as sustainability advisor, actively guiding COFCO's selection of KPIs. COFCO's KPIs focus on soy supply chain traceability in Brazil and their global palm oil supply chain. These objectives

underscore COFCO's commitment to responsible sourcing, environmental accountability, and ethical business practices.

TABLE C6. COFCO's SLF Framework Assessment

Assessment criteria	Key findings
Incorporation of A&R indicators	COFCO's SLL facilities focus on supply chain traceability, evaluating direct palm oil suppliers, and assessing social aspects of palm oil farms to tackle climate risks and deforestation and promote social resilience. KPIs are instrumental in monitoring the product lifecycle and safeguarding communities (OECD & FAO, 2023; UKSA, 2018)
Establishment of indicators through a risk assessment process	COFCO, in collaboration with The Nature Conservancy and WWF, conducted a risk analysis identifying threats like deforestation, soil erosion, and extreme weather events in Brazil. They have achieved an 88% tracking rate for global palm oil supply and full soy traceability in Brazil's Matopiba region, supported by technology and training (COFCO, 2022).
Alignment with long-term A&R objectives	COFCO aims to foster sustainable supply chains globally, with KPIs focused on water conservation, soil health, and environmental and social assessments. Their SLF is aligned to achieve a deforestation and conversion-free supply chain in sensitive Latin American regions by 2030 (COFCO, 2022).
Consideration of social and environmental safeguards	COFCO mandates sustainable sourcing standards, utilizing satellite mapping and collaborations with organizations like the IFC to promote environmental responsibility. Their monitoring and assessment protocols ensure that ecosystems and supply chains remain protected and sustainable (COFCO, 2021).
Enhancing resilience beyond enterprise value	Beyond corporate immediate interests, COFCO contributes to regional resilience through biodiversity conservation, soil health, and climate regulation efforts. They also empower local communities with agricultural training and capacity-building initiatives, promoting sustainable production practices that enhance local livelihoods and the agrifood sector's overall resilience (Ayompe et al., 2021; IPCC, 2021; Meubeck et al., 2021).

COFCO's SLF framework demonstrates a commitment to climate action through supply chain traceability and sustainability goals. However, it faces challenges like data collection, verification, and enforcement, which could hinder its effectiveness. Additionally, an excessive focus on traceability may overshadow other factors that could enhance climate resilience, such as infrastructure or ecosystem preservation. COFCO also recognizes regulatory risks linked to land use compliance and national deforestation policies. Changes in regional regulations could disrupt supply chains and sustainability efforts. Lastly, COFCO's 2030 targets are commendable, but sustaining efforts beyond that date is vital for long-term benefits to both the company and the communities it serves.

TABLE C7. COFCO's SLF Framework Summary

Instruments	3 SLLs	*Total issuance*	USD 4.4 billion
Market of issuance	China	*Period of issuance*	2019-2022
Stakeholders	Syndicated group of banks: Bank of China, BBVA, SMBC, ING, Natixis, Rabobank, ABN AMRO, and ANZ Bank. Sustainability Advisor: BBVA		
*Financial structure**	Credit facilities (pre-approved line of credit).		
Issuer's reputation	COFCO ranks among the industry's sustainability leaders, with a dedicated focus on agricultural commodities traceability and rigorous environmental assessments. Their commitment to sustainable practices is evidenced through successful projects and partnerships with international organizations like IFC and UNDP.		
KPIs in the SLF Framework	*Mitigation, Adaptation and Resilience (MAR) KPIs* • Evaluation of total direct palm oil suppliers. • Percentage of palm oil traceability to mill. • Social assessments for 85% of direct supplying farms in Brazil's Matopiba region. • Full traceability to farm for directly sourced soy from Brazil.		
KPIs in the CARP *A&R KPIs from CARP, which are not present in the SLF framework, suggest potential future transaction metrics.*	Supply chain traceability • Achievement of deforestation and conversion-free soy supply chain by 2030 in sensitive regions of Latin America. • Percentage of directly supplying farms with environmental and social assessments. • Percentage of soybean sourced from Brazil traceability to farm. • Percentage of palm oil volumes covered by re-evaluation of supplier sustainability performance.		

Sources: COFCO (2022), Environmental Finance (2023), and Bloomberg (2023).

Note: (*) Syndicated loan markets pose challenges in accessing detailed financial structure information due to their private nature, diverse lender base, and limited regulatory oversight. Unlike the more transparent and standardized bond market, syndicated loans often feature heterogeneous terms tailored to borrower and lender preferences, resulting in limited public disclosure and secondary market liquidity.

Case Study E: Enel. — Enel is a compelling case study demonstrating the impact of EU Taxonomy A&R criteria on capital allocation in sustainability-linked finance in developing countries. Globally recognized for its leadership in sustainable finance, Enel is the first issuer to integrate A&R into its SLF framework strategy, specifically focusing on a KPI assessing capital expenditure alignment with the EU Taxonomy. The EU Taxonomy recognizes activities contributing to climate adaptation, particularly within electricity distribution (EC, 2021). Enel, a significant player in Chile's electricity sector, aims to enhance portfolio resilience by increasing capital expenditure allocation for grid infrastructure to 34% by 2025 (Enel, 2022a). This underscores Enel's proactive approach in aligning financial investments with sustainability goals and addressing climate and energy resilience.

Enel was the first company in the world to issue an SLB in 2019, and it has since become the largest issuer of SLBs globally. Enel's SLF framework comprises six SLLs and 12 SLBs

with a total issuance of USD 23.7 billion and USD 31 billion, respectively, issued in the Italian market from 2019 to 2023. A syndicate of leading banks, including Citigroup as the Lead Arranger, played a crucial role in this initiative. Verifiers such as Latham & Watkins and Moody's ESG endorse the framework's integrity. The financial structures involve fixed interest rates for the bonds, contingent on meeting sustainability targets, with a 25-basis point interest rate increase if targets are missed.

TABLE C8. Enel's SLF Framework Assessment

Assessment criteria	Key findings
Incorporation of A&R indicators	Enel's SLF is focused on energy resilience, including an indicator for capital expenditure alignment with the EU's taxonomy, in response to increased severe weather events affecting electricity infrastructure due to climate change (Enel, 2023). Maintaining energy supply amidst disruptions is a key focus (Zamuda et al., 2019).
Establishment of indicators through a risk assessment process	The company uses IPCC scenarios and collaborates with organizations like the International Centre for Theoretical Physics (ICTP) for regional climate projections. Enel focuses on energy resilience against physical impacts, transitioning to a net-zero emissions economy, and investing in smart grid technology, digitalization, and network quality improvements (Enel, 2021).
Alignment with long-term A&R objectives	Enel's SLF aligns with its CARP, showing a solid commitment to sustainability and risk mitigation. Their focus includes grid reinforcement in developing countries and transitioning to a net-zero future while integrating renewable energy. Investor confidence remains strong despite potential near-term challenges (Hwang, 2023).
Consideration of social and environmental safeguards	Enel adheres to the Do No Significant Harm (DNSH) principle, conducting detailed analyses tailored to different contexts to avoid causing significant harm to environmental objectives. Their commitment extends across the Enel Group, reflecting a holistic approach to upholding essential social standards while pursuing climate A&R.
Enhancing resilience beyond enterprise value	Enel's 2023-2025 Strategic Plan involves a $37 billion investment focusing on energy resiliency in Italy, Spain, Brazil, Chile, and Colombia. Their alignment with the EU Taxonomy and UN SDG 13 underscores their commitment to strategic decarbonization, climate change mitigation, and global climate action, enhancing corporate and broader regional resilience (Enel, 2022b).

Enel's approach to A&R through SLF carries notable risks and challenges. A lack of specific indicators for EU Taxonomy alignment introduces ambiguity in assessing their performance. Their complex risk assessment process may not be easily replicable, and financial penalties for missed targets can strain resources. Enel recognizes that climate risks faced by the energy sector, if not effectively addressed, may result in frequent operational disruptions, equipment and property damage, service failures, and regulatory non-compliance.

TABLE C9. Enel's SLF Framework Summary

Instruments	7 SLLs and 12 SLBs	*Total issuance*	25.3 billion USD (SLLs) 31 billion USD (SLBs)
Market of issuance	Italy	*Period of issuances*	2019-2023
Stakeholders	Syndicated group of banks: Bank of America Merrill Lynch, Barclays, Banca Akros, Banca IMI, BBVA, BNP Paribas, BPER Banca, CaixaBank, Citigroup, Commerzbank, Credit Agricole CIB, Credit Suisse, Deutsche Bank, EKF, European Investment Bank, Goldman Sachs, HSBC, ING, Intesa Sanpaolo, JP Morgan, Mizuho, Mediobanca, Morgan Stanley, MUFG Securities, Natixis, Santander, SMBC, Société Générale, Unicredit, Unipol Gruppo, Wells Fargo Lead Arranger: Citigroup Verifiers: Latham & Watkins, Tremonti Romagnoli Piccardi e Associati, White & Case, Allen & Overy, Maisto e Associati, Shearman & Sterling, Simmons & Simmons, Moody's ESG, Vigeo		
*Financial structure**	Credit facilities (pre-approved line of credit). SLBs feature a fixed interest rate until maturity, tied to sustainability targets. Failure to meet these targets triggers a 25-basis point interest rate increase through a step-up mechanism.		
Issuer's reputation	Enel excels in renewable energy generation and efficient energy distribution. Consequently, it consistently earns top rankings in ESG indices, boasting an AAA rating in MSCI, an A rating in CDP for climate, and a 90 in the S&P ESG score. Furthermore, Enel has pioneered alignment with the CA100+ Net Zero Company Benchmark, all driven by its ambitious goals of achieving emissions neutrality by 2040, increasing renewable energy generation, minimizing ecosystem impact, and optimizing supply chain circularity by input optimization.		
KPIs in the SLF Framework	*Mitigation KPIs* • Scope 1 GHG emissions Intensity relating to Power Generation (gCO2eq/kWh). • Scope 1 and 3 GHG emissions Intensity relating to Integrated Power (gCO2eq/kWh). • Absolute Scope 3 GHG emissions relating to Gas Retail (MtCO2eq). • Renewable Installed Capacity Percentage (%).		
	MAR KPIs • Proportion of CAPEX aligned to the EU Taxonomy (%)		
KPIs in the CARP *A&R KPIs from CARP, which are not present in the SLF framework, suggest potential future transaction metrics.*	• Energy distributed by smart grids (TWh). • Number of active smart meter users. • Km of network digitalized by smart grids. • System Average Interruption Duration Index (SAIDI). • System Average Interruption Frequency Index (SAIFI).		

Sources: Enel (2022a), Environmental Finance (2023), and Bloomberg (2023).
Notes: (*) Syndicated loan markets pose challenges in accessing detailed financial structure information due to their private nature, diverse lender base, and limited regulatory oversight. Unlike the more transparent and standardized bond market, syndicated loans often feature heterogeneous terms tailored to borrower and lender preferences, resulting in limited public disclosure and secondary market liquidity.

Case Study F: Iberdrola. — Iberdrola, a leading global clean energy company headquartered in Spain, partnered with BBVA to introduce a landmark SLF structure valued at USD 2.7 billion, emphasizing its commitment to achieving water resilience-related objectives (EF, 2023). Iberdrola's SLF has been recognized as a benchmark in best practices (London et al., 2022). It incorporates water to address industries with substantial water consumption, such as

water conservation and the CDP Water Rating (see further details in Table 19). Iberdrola's approach addresses water security and associated economic risks by promoting water-efficient practices while incentivizing responsible water management.

Water security represents a critical, often underestimated facet of climate A&R efforts, particularly when considering the operations of electric utilities. Given the likelihood of climate change exacerbating water scarcity in various regions (e.g., Ganguli et al., 2017; WRI, 2019), coupled with a projected increase in global energy demand, the risks posed to electricity generation and the financial performance of utilities are tangible. Failure to address these water-related risks can result in operational disruptions, heightened costs, and reputation damage (Hernanz Lizarraga, 2021). On a global scale, it is worth noting that by 2050, water scarcity in specific regions could potentially impact GDP growth by up to 11.5% (BBVA, 2022). These statistics underscore the urgency and elevate the water footprint to a priority regarding A&R outcomes.

Iberdrola's SLF Framework encompasses four SLLs) with a total issuance of USD 14.3 billion, primarily issued in the Spanish market between 2018 and 2022 (see Table 20). Key stakeholders in these transactions include a syndicated group of banks serving as Sustainability Advisors, including BBVA, ING, Natixis, and UniCredit. Moody's ESG and Vigeo act as verifiers. Mitigation, Adaptation, and Resilience (MAR) KPIs involve water consumption, CDP Water rating, and water management. Iberdrola's commitment to sustainability is exemplified by its reputation as one of the most sustainable electric companies globally, endorsed by DJSI World, MSCI ESG Ratings (AAA), CDP (A rating), and S&P Global ESG Score (top 5%). In this case study, our focal point centers on the CDP scoring information (CDP, 2020).

TABLE C9. Iberdrola’s SLF Framework Assessment

Assessment steps	Key findings
Incorporation of A&R indicators	Iberdrola's SLF framework features KPIs targeting a 50% reduction in water usage for energy generation by 2030, alongside a CDP Water scoring system for evaluating water risk management and best practice compliance (CDP, 2015). To date, their thermal generation, responsible for 90% of total water withdrawal, sees 96% safely returned to the environment without harm.

Establishment of indicators through a risk assessment process	Iberdrola conducts regular water-related risk assessments using tools like WRI Aqueduct, Environmental Impact Assessment, Life Cycle Assessment, IPCC Climate Change Projections, FAO/AQUASTAT, and regional government databases, projecting risks for the upcoming six years (Iberdrola, 2022).
Alignment with long-term A&R objectives	Iberdrola's approach to water security is strategically aligned with short-term actions and long-term goals, demonstrated by monitoring all their sites for water metrics and pledging not to operate in water-stressed areas. A 27% reduction in water withdrawals and discharges from 2019 to 2020 underscores their commitment to sustainable water practices (Iberdrola, 2022).
Consideration of social and environmental safeguards	The company actively monitors ecosystems and complies with environmental permits, taking steps to mitigate impacts on water resources and habitats. Efforts include restoring ecosystems affected by their operations and maintaining ISO 14001 certification to identify and manage risks like eutrophication and ecotoxicity (CDP, 2020).
Enhancing resilience beyond enterprise value	Iberdrola's efforts to improve infrastructure and offer professional training in communities near its facilities enhance local resilience. Their contributions to communication infrastructure, water supply, roadways, public lighting, employment, and training support the communities' capacity to cope with adverse events and contribute to their economic stability.

In analyzing Iberdrola's 2020 Water Security report, it becomes evident that while the company has made relevant advances in sustainable water usage, there remain inherent risks in its A&R strategy. The company's heavy reliance on freshwater sources, accounting for a significant volume of 97,592,288 megaliters in 2019, underscores a potential vulnerability, especially in the face of unpredictable climate patterns and likely future water scarcity. Moreover, while Iberdrola asserts that they do not operate in water-stressed areas, the changing global climate landscape could redefine such regions, potentially impacting their operations. Although seemingly positive, the 27% decrease in water withdrawals and discharges from the previous year could also indicate a reduced capacity for energy production or shifts in operational dynamics. As water is intrinsically tied to Iberdrola's energy production, particularly in thermal generation, any disruptions or inefficiencies in water management could have cascading effects on the company's overall output and profitability.

TABLE C10. Iberdrola's SLF Framework Summary

Instruments	4 SLLs	Total issuance	14.3 billion USD
Market of issuance	Spain	Period of issuance	2018-2022
Stakeholders	Syndicated group of banks: BBVA, ING, Natixis, UniCredit Sustainability Advisor: BBVA, UniCredit Verifiers: Moody's ESG, Vigeo,		
Financial structure*	Credit facilities (pre-approved line of credit).		

Issuer's reputation	Iberdrola has restructured its business model for sustainability, leading efforts to reduce its environmental impact and maintain a reliable supply. It is recognized as one of the world's most sustainable electric companies, with accolades including an AAA rating in MSCI ESG Ratings, an A rating from CDP, and a top 5% ranking in the S&P Global ESG Score.	
KPIs in the SLF Framework	Mitigation KPIs	• CO2 emissions intensity, measured in grams per kilowatt-hour produced (g/kWh) • Percentage of women in leadership positions • Installed renewable capacity within the group. • Number of people in developing countries benefiting from access to electricity • CO2 emissions intensity, measured in grams per kilowatt-hour produced (g/kWh)
	MAR KPIs	• Amount of water consumed by the Group in its own or controlled production facilities and not returned to the environment, measured in cubic meters (m3) per gigawatt-hour of energy produced (m3/GWh). • Rating assigned to Iberdrola by the independent agency CDP Water • Amount of water consumed by the Group in its own or controlled production facilities and not returned to the environment, measured in cubic meters (m3) per gigawatt-hour of energy produced (m3/GWh)
KPIs in the CARP		
A&R KPIs from CARP, which are not present in the SLF framework, suggest potential future transaction metrics	• The percentage of water collected in thermal generation and cooling returned to the environment. • Water collected saved through reuse in closed or semi-open cycles (hm3). • Water recycled in cooling processes (hm3).	

Sources: Iberdrola (2022), Environmental Finance (2023), and Bloomberg (2023).
Notes: (*) Syndicated loan markets pose challenges in accessing detailed financial structure information due to their private nature, diverse lender base, and limited regulatory oversight. Unlike the more transparent and standardized bond market, syndicated loans often feature heterogeneous terms tailored to borrower and lender preferences, resulting in limited public disclosure and secondary market liquidity.

Appendix D. Methodology for stock-take analysis of metrics and targets.

Taxonomy-Indicators Comparative Analysis. In terms of KPI classification, we have formulated a novel taxonomy to capture outcomes related to adaptation, resilience, and combined benefits from mitigation and A&R. This classification draws from the scholarly works of Sadler et al. (2023) that focus on the nexus between fiscal policies and A&R outcomes. Additionally, our framework used keywords from the Global Centre on Adaptation (GCA, 2021), particularly in the context of green bonds that support climate resilience. Another source we used is the Climate Bonds Initiative's (CBI, 2019) framework, which presents definitions and criteria that investors and issuers can employ to classify climate resilience investments systematically, consistently, and transparently. It is worth noting that none of these

approaches cover all the KPIs we found in our stocktake of the sustainability-linked finance market. Still, their methodologies contributed to the refinement of our taxonomy.

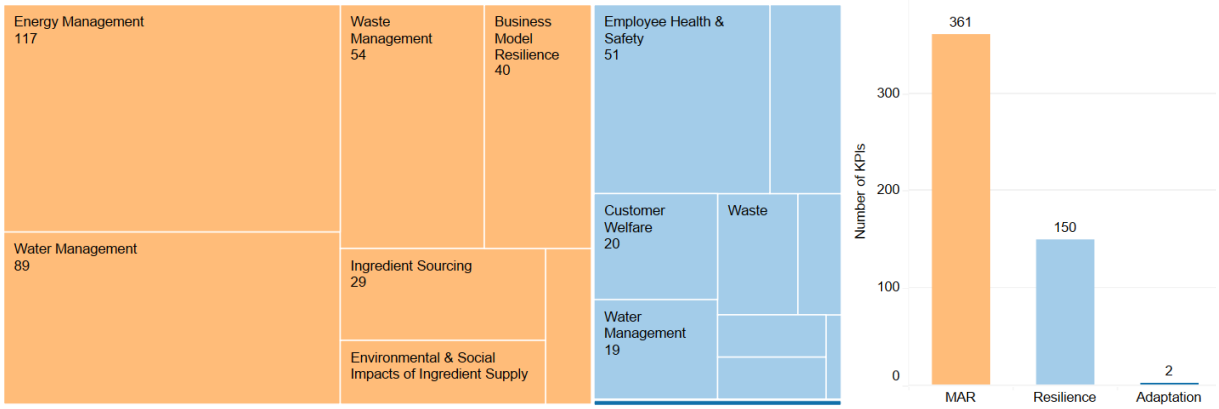
- **Sadler et al.'s Dictionary** proposes a climate dictionary to identify A&R-related terms in fiscal policies through deep learning techniques. According to their impact, they classify climate-related keywords into A&R, mitigation, or both. This classification of Fiscal Measures draws from the fiscal policy framework developed by the Global Recovery Observatory and an extensive literature review. They incorporate relevant climate-related policy archetypes and score them according to their potential positive, neutral, or negative impact on direct or indirect A&R. Direct A&R is defined as the explicit efforts to adapt to climate effects, while indirect A&R, which refers to the attempts to increase resilience of reduce vulnerability to climate effects. While robust, this taxonomy considers sectors out of the scope of this research and does not look at the corporate perspective of actions.
- **GCA** developed a framework to identify green bonds financing resilience-related assets and projects. They cover multiple sectors and attribute them resilience keywords, reflecting the understanding of climate risks faced by each.
- **CBI** has designed a sectorial resilience classification framework to promote and facilitate investment in climate resilience in capital markets. It is intended to encompass a range of sectors, identifying their crucial resilience topics. Its foundations lay on other relevant taxonomies such as United Nations Development Program and EU Sustainable Finance Taxonomy.

Building upon these taxonomies, we developed an approach to cover SLF KPIs, recognizing sectorial differences, impacts and co-benefits in terms of mitigation and A&R. As a result, our approach is more comprehensive. It allows us to cover all SLF KPIs topics, reflecting SLF's current market state and corporate priorities regarding A&R and mitigation. Therefore, our methodology is divided into four categories: mitigation, adaptation, resilience and MAR, which merge elements from all three.

The figures presented below illustrate the classification of indicators in our tracking system Figure A.1) and within other taxonomies (Figures A.2, A.3, and A.4) focused on the selected

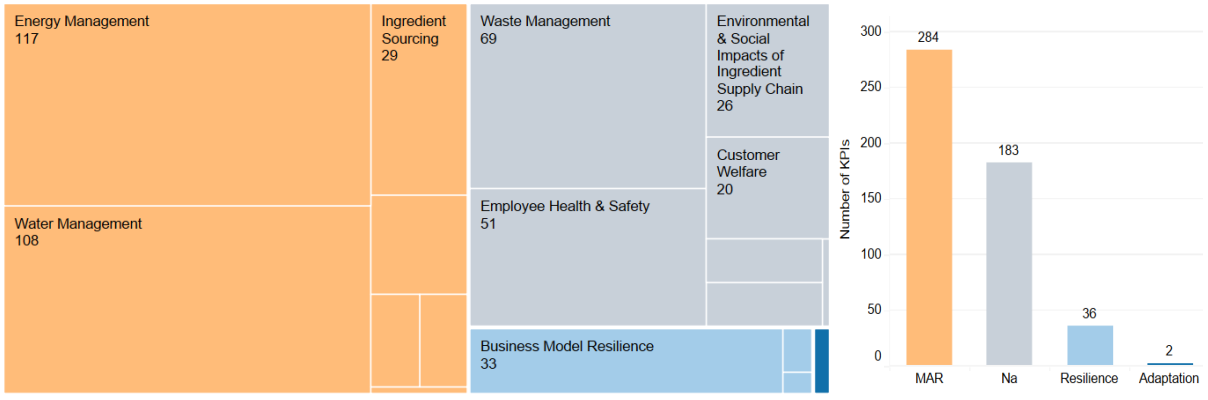
industries: electric utilities, real estate, and agrifood. The numbers provided indicate the count of these indicators associated with adaptation, resilience, MAR, or marked as not applicable (na) when not included in the assessment. This analysis enables a comprehensive understanding of the variations and commonalities in classifying and integrating KPIs among different taxonomies.

Figure D.1 SLF Performance Metrics for A&R



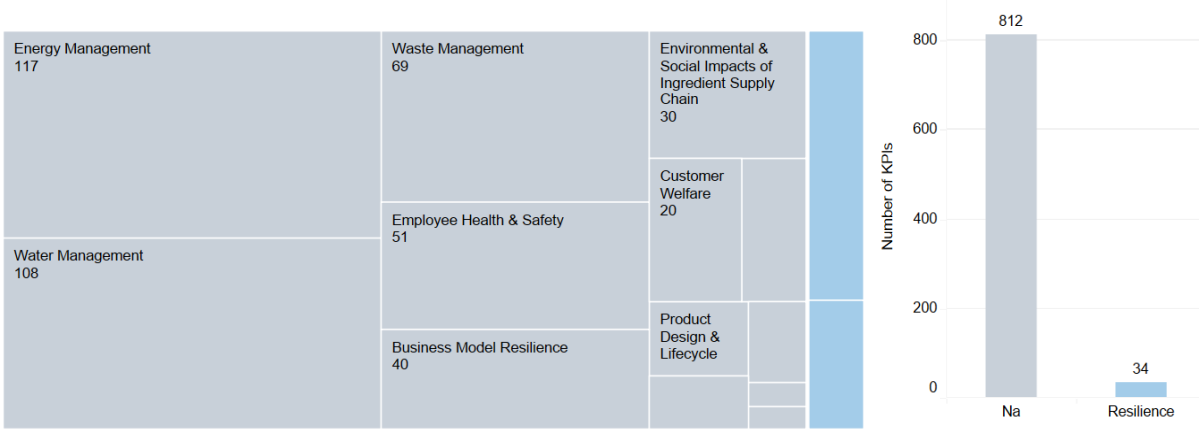
Note: KPI topics legends missing. MAR: product design & lifecycle management (11). Resilience: environmental and social impacts of the ingredient supply chain (21), ingredient sourcing (8), access & affordability (7), ecological impacts (7). Adaptation: climate change adaptation (2).

Figure D.2 Classification of KPIs by topics in the Sadler et al. (2023) dictionary



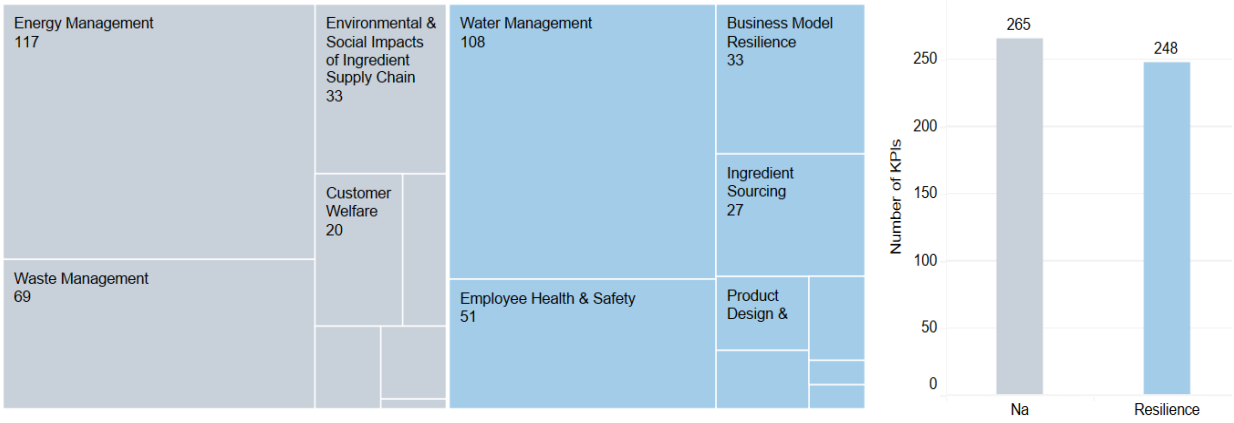
Note: KPI topic legends missing: MAR: environmental and social impacts of the ingredient supply chain (15), ecological impacts (7), business model resilience (7), product design (1). Na: access & affordability (8), ingredient sourcing (8), product design (1). Resilience: systemic risk management (1).

Figure D.3 Classification of KPIs by topics in the Sadler et al. (2023) classification of fiscal measures



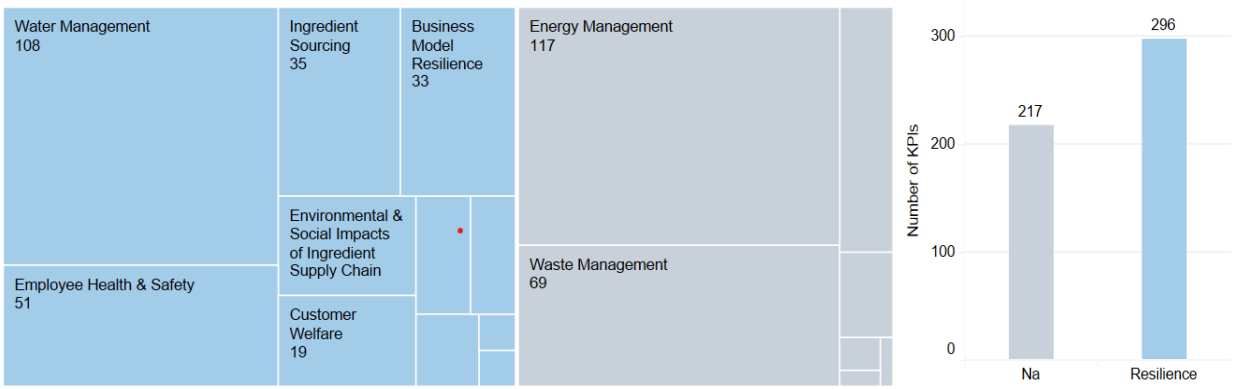
Note: KPI topic legends missing: Na: ingredient sourcing (14), access & affordability (8), ecological impacts (7), and systemic risk management (2), climate change adaptation (2). Resilience: ingredient sourcing (23), environmental and social impacts of the ingredient supply chain (11).

Figure D.2 Classification of KPIs by topics in the Global Centre on Adaptation Taxonomy



Note: KPI topic legends missing: Na: access & affordability (8), ingredient sourcing (10), business model resilience (7). Resilience: environmental and social impacts of ingredient supply chain (8), and ecological impacts (7), systemic risk management (2), climate change adaptation (2).

Figure D.5 Classification of KPIs by topics in the Climate Bonds Initiative Taxonomy



Note: KPI topic legends missing: Resilience: climate change adaptation (2), access and affordability (8), ecological impacts (7), product design (2), systemic risk management (2) Na: environmental and social impacts of the ingredient supply chain (20), business model resilience (7), ingredient sourcing (2).

Our taxonomy is aligned with the IFRS S2 Climate-related Disclosures (ISSB, 2022). This means that the above-listed topics correspond to the ones of the IRS standards. Therefore, we could classify each industry's KPI topic and consistently identify their A&R and mitigation outcomes.

- First, we classified individual KPIs for each industry according to the IFRS Climate-Related Disclosures, which encompasses an industry classification and specific sustainability disclosure topics and metrics for the KPIs. They offer industry-based guidance derived from SASB Standards and maintained by the IFRS.
- Second, we classified each KPI into four categories: mitigation, adaptation, resilience, and MAR. For example, a KPI addressing water reduction measured by the decrease in m3 of water employed is classified as water management in IFRS standards and as MAR in line with the taxonomy.

This methodology allowed us to frame each KPI's adaptation, resilience and mitigation impact incorporated in SLF instruments and CARPs while classifying it according to IFRS standards.

Table D.1 KPIs included in the Climate Adaptation and Resilience Plans of issuers in the real estate industry targeting mitigation, adaptation, and resilience outcomes.

MAR	Adaptation	Resilience
Energy Management % of energy-efficient lighting across the portfolio Energy consumption (MWh, GWH, kWh, GJ) Energy Use Intensity (kWh/ft2, kWh/m2) Occupier Energy Intensity/ net lettable area (kWh/sqft) **Product Design & Lifecycle Management** % of green lease adoption % of new leases that contain a cost recovery clause for resource efficiency-related capital improvements % of tenants in the office portfolio that signed a Green Performance Pledge % of tenants purchasing renewable electricity % of tenants that are separately metered or sub-metered for water withdrawals/grid electricity consumption Electricity(sub)metered exclusively to tenants Number of Green leases signed by tenants Total area and percentage of tenants that have a cost recovery clause for improved resource efficiency (m2) **Water & Wastewater Management** Water consumption (m3, GAL, kGAL) Water consumption intensity (m3/m2, m3/sq.m, gal/ft2)	**Climate Change Adaptation** % of assets exposed to climate change risk with adaptation plans % of buildings with plans in place to mitigate the physical effects of climate change % of the current lettable area (sq ft) located in flood zones % of portfolio covered by climate risk assessments % of portfolio's exposure to climate-related risks such as flooding, rock falls/ landslides/erosion, and heavy snow loads Annual TCFD reporting Area of properties located in 100-year flood zones External wall insulation (m2) Million USD associated with climate change adaptation solutions Million USD related to coastal resilience Million USD associated with coastal resilience Number of properties with Climate risk assessments for 2030 and 2050, based on IPCC AR5 projections Number of properties with flood control measures Number of property assets with climate risk assessments: sea level rise, heatwave, water stress, flood, wildfire, cold wave and hurricane Roof insulation (m2)	**Ecological Impacts** TNFD (Taskforce on Nature-related Financial Disclosures) reporting. **Waste & Hazardous Materials Management** Use of recycled/ recovered materials (%) Recycled materials (mt) Reduction on non-renewable materials reliance (%) Use of natural bioengineering materials (%) Waste recycled (t) Waste generated (t) **Water Management** Total water extraction (m3/year) by source (surface, ground, purchased) Water Withdrawal by Corporate Office and Managed Buildings (m3)

Source: Authors.

Table D.2 KPIs included in the Climate Adaptation and Resilience Plans of issuers in the agrifood industry targeting mitigation, adaptation, and resilience outcomes.

MAR	Adaptation	Resilience
Energy Management Energy consumption: MWh, KWh Energy intensity: Khw/t, Mwh/kg product **Environmental & Social Impacts of Ingredient Supply Chain** % of biodegradable packaging % of compostable packaging % of free deforestation supply chain % of recycled pet bottles % of recycled plastic in new bottles % recyclabe packaging Increasing PET recycled content in PET primary packaging Number of countries implementing a system for collecting and for recycling empty packaging Plastic use reduction in packaging (%) **Ingredient sourcing** % of purchase of agricultural inputs from family farms % responsible sourcing of raw materials and ingredients used for feed production Increase in the percentage of goods sourced from certified growers in high and medium risk countries Ingredients supply chains are Rainforest Alliance Certified (% share of total volumes) Number of farmers successfully completing the forest management certification provided by the Forest Stewardship Council. "Number of plantations that have undergone a DRA (Deforestation Risk Assessment)" Percentage of ingredients sourced form high risk countries Regenerative agriculture practices Seed supply farms monitored (%) **Land Use & Ecological Impacts** Manure recycled (t) Pesticide application reduction (%) **Waste & Hazardous Material Management** Waste generated (t)	**Climate Change Adaptation** Annual TCFD reporting Flood risk assessments Soil erosion assessments Water related risk assessments	**Customer Welfare** % of brands to have a positive impact in nutrition and health % of no- sugar drinks Nutritional information on packages Share of Products with Increased Nutrient Content Zero-use of antibiotics **Employee Health & Safety** Frequency rate of occupational accidents (LTIFR) Frequency rate of occupational accidents with lost time Incident rate reduction LTIR per 200,000 hours worked Number of work-related accidents Reduction of work accidents injurie rate Total recordable incident rate Zero work-related fatalities **Environmental & Social Impacts of Ingredient Supply Chain** % raw material supply chain traceability **Ingredient sourcing** **Water Management** % of reused water Water stress reduction (m3) Water withdrawal (m3)

Waste recycled (t) **Water Management** Water consumption (m3, GAL, kGAL) Water consumption intensity (m3/mt, m3/production, m³/MT FFB processed, lts/$ sales)		

Source: Authors.

Table D.3 KPIs included in the Climate Adaptation and Resilience Plans of electric utility issuers targeting mitigation, adaptation, and resilience outcomes.

MAR	Resilience
Business Model Resilience Customer gas savings from efficiency measures by market (MMBtu) Installed smart energy meters (millions) Number of Smart Meters installed Percentage of electric load served by smart grid technology Power supplied GWh/yr Production efficiency [(kWhe+ kWht) / kWh combined] % **Water Management** Freshwater consumption intensity for energy generating assets m3/MWh Freshwater intensity m3/MWh Water consumption: m3, KL, ML3 Water intensity: water consumed/electricity generated by fleet (l/kWh), kg product/m3, m3/year, m3/MWh, m3/GWh **Waste & Hazardous Material Management** % of waste recycled or recovered % of waste diverted from landfill Amount of Coal Combustion Residuals Generated (MT) Coal ash produced (MT) Hazardous waste disposed (t) Hazardous waste for reutilization (t) High-level radioactive waste (metric tons) Recycled ashes (KT) Waste generated (MT) Waste generated by business and main materials (t)	**Critical Incident Risk Management** % of nuclear station operators' time is spent in classroom and simulator training Number of incidents on the seven-step international nuclear event scale Number of significant level-2 events on the INES scale Total number of nuclear power units that are owned and/or operated Total Number of Nuclear Power Units, Broken Down by Nuclear Regulatory Commission (NRC) Action Matrix Column **Employee Health & Safety** Accident frequency rate Accident frequency rate Reportable accidents per million-man hours Employee High-Risk Incident Rate % Lost Time Incident Severity Rate (LTISR) Near-Miss Frequency Rate: # of Near Misses Reported / Total Hours Worked Number of annual Occupational Health Physician inspections performed/planned. Number of courses: Health and safety training Number of deaths resulting from occupational diseases Number of Electrocution Number of Injuries in the workplace Number of serious injuries Recordable Incident Rate Share of employees that have recorded incidents of stress — both light and heavy cases (%) TRIF: number of reported fatalities and occupational injuries and illnesses per million hours of work **Systemic Risk Management**

Waste to Landfill and Scrap Metal Recovered (t)	% of staff that completed at least one training module in the cyber field Average no. of interruptions per LV customer Grid-scale batteries installed and managed (MW) Megawatt hours (MWh) not supplied Number of incidents of non-compliance with physical and/or cybersecurity standards or regulations Number of internal employees trained in cybersecurity SAIDI (System Average Interruption Duration Index) hours and minutes **Water Management** % Water network leaks Recycled Water (m3) Total water consumed, percentage in regions with high or extremely high baseline water stress (ML) Total water discharge thousands of m3 Total water withdrawn (m3) Total water withdrawn, including % in regions with High or Extremely High Baseline Water Stress Water reused/recycled (million liters/net MWH) Water withdrawal- thermal generation (hm3) Water withdrawn by source (m3)

Source: Authors.

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