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Asset Management

Sustainable Fixed Income in a Disrupted, Energy-Hungry World

The Amova Asset Management Sustainable Fixed Income Guide

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Foreword

Welcome to the 2026 version of our sustainable fixed income investment guide. The world looks very different from just three years ago, when we published the first edition of this guide. The benign globalisation that shaped the early decades of this century has given way to something more contested, more fragmented, and considerably more volatile. Energy, food, water and critical infrastructure are no longer taken for granted. They are strategic assets, and the capital flows that support them are being reshaped accordingly.

At the same time, artificial intelligence (AI) is restructuring the global economy at a speed that few anticipated. AI is not purely a technology story, but also an energy story. The infrastructure required to support it, from data centres and power grids to storage and transmission networks, is driving a structural increase in electricity demand that will define energy investment for the next decade and beyond. The question of where that capital comes from matters enormously, and we believe green bonds can help answer that question. They were designed to connect long-term capital with long-term infrastructure, with full transparency over where the money goes and what it finances. That transparency, which distinguishes sustainable fixed income from conventional debt, has never been more valuable than it is today.

I've been managing Amova AM's Global Green Bond strategy since 2015. Before that, we were instrumental in launching the world's first dedicated World Bank Green Bond Fund in 2010. In that time, I've watched the market grow from a specialist niche into a core component of global fixed income, and I've watched the debate around it evolve in ways that have not always served investors well. Perhaps the most persistent example is around the greenium. The assumption that investors must sacrifice yield to invest sustainably has been repeated so often it's become accepted wisdom. For this edition of the guide, our research team conducted an original study of the global green bond market, covering approximately 2.1 million data observations across currencies, sectors and rating categories from 2017 to the present. We found that in most markets, the yield cost of the green label is negligible. In some, investors are paid more for holding green bonds, not less.

We believe this research, the most comprehensive analysis of green bond pricing we know of, should put the greenium question to rest for investors.

In fact, the investment case for sustainable fixed income has broadened considerably since the last edition. Climate ambition remains part of it, but energy security, economic resilience and the sheer scale of infrastructure capital required to support digital transformation have added new and powerful dimensions. Green, Social and Sustainability Bonds have evolved from environmental instruments into practical financing tools for the infrastructure that modern economies cannot function without.

This guide reflects that evolution. It is written for investors who want to understand not just what sustainable fixed income is, but why it belongs at the core of a well-constructed fixed income portfolio, and how to navigate a market that rewards rigorous analysis over labels. We hope you find it useful.

Steve Williams
Head of Amova AM
Global Fixed Income Team

Chapter 1

The evolution of the green bond universe

The evolution of the green bond universe

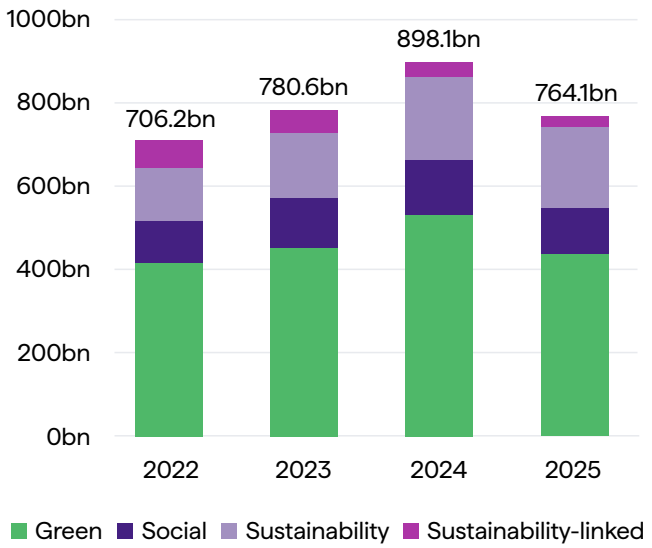
In 2008, recognising the risks posed by climate change, and the need to motivate public and private sector activity to combat it, the World Bank developed the concept of sustainable, or 'green' bonds. In doing so, it set the template for the modern green bond market.

Since then, aligned green bond issuance – from a combination of multilateral development banks, governments and companies across both the developed and developing world – has grown from less than USD 50 billion in 2015[1] to more than USD 764 billion in 2025. This means cumulative issuance across the sustainable debt market is now approaching USD 7 trillion.[2] Green bonds have grown from a relatively niche instrument into a mainstream pillar of global fixed income, representing a significant share of total global bond issuance.

However, this growth has not been without interruption. In particular, rising interest rates and destabilising geopolitics during 2022 weighed on issuance. Global issuance dipped again in 2024, largely as a result of macro uncertainty, political division, geopolitical headwinds, and the end or weakening of green incentives in some markets, especially the US. But the market has proved resilient, resuming its growth trajectory and broadening its geographic and sectoral reach. What was once dominated by European supranational issuers now spans sovereign, corporate and financial institution issuers across multiple regions and currencies, albeit with Europe still the dominant issuer by region.

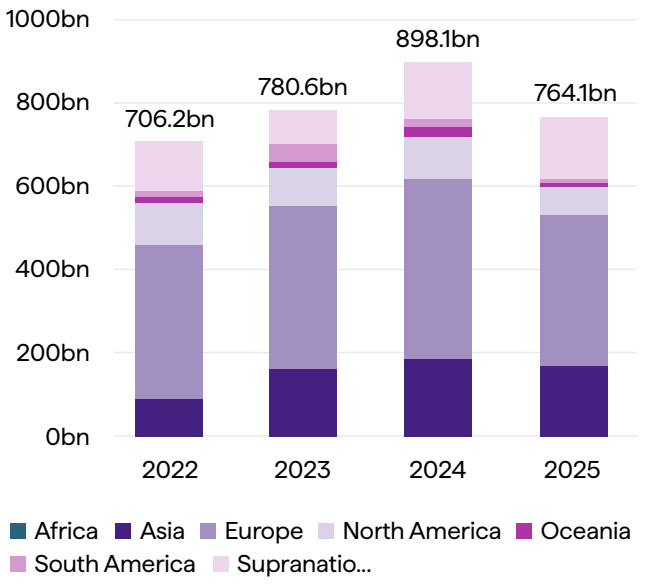
1 https://www.bbva.com/en/2015-record-year-issuance-green-bonds/
2 World Bank reports the cumulative amount of green, social, sustainability, sustainability-linked and transition bond issuance reached USD 6.81 trillion as of December 2025

Chart 1 Sustainable Bond issuance per catagory (USD bn)



Source: ICMA Group, May 2026 (https://www.icmagroup.org/sustainable-finance/sustainable-bonds-database/)

Chart 2 Sustainable Bond issuance per region (USD bn)



Source: ICMA Group, May 2026 (https://www.icmagroup.org/sustainable-finance/sustainable-bonds-database/)

Defining the Green Bond universe

The rapid growth of sustainable fixed income has brought with it a proliferation of bond types, structures and labels that can be confusing for investors. To bring order to this complexity, the International Capital Market Association (ICMA) published a set of principles for different sustainable bond categories, providing common definitions, and recommending standards for transparency, disclosure and reporting. These principles have become the market standard: in 2023, an estimated 97% of sustainable bonds issued internationally referenced them.

ICMA defines the main categories as follows:

Green Bonds are bond instruments where proceeds are exclusively applied to finance or refinance projects with clear environmental benefits. Eligible project categories include renewable energy, energy efficiency, clean transportation, sustainable water management, pollution prevention, biodiversity conservation, climate change adaptation, and green buildings.

Social Bonds finance projects that directly address or mitigate a specific social issue and seek to achieve positive social outcomes, particularly for a defined target population. Eligible categories include affordable housing, access to essential services, food security, employment generation, and socioeconomic advancement.

Sustainability Bonds combine both objectives, with proceeds applied exclusively to a mix of green and social projects. They are aligned with both the Green Bond Principles and the Social Bond Principles, and follow the same disclosure and reporting standards.

Sustainability-Linked Bonds work differently from the three categories above. Rather than ring-fencing proceeds for specific projects, they tie the financial or structural characteristics of the bond, typically the coupon, to the issuer's performance against pre-defined sustainability key performance indicators and targets. This makes them available to a broader range of issuers, including those whose activities do not lend themselves to a specific use-of-proceeds structure. They have, however, attracted scrutiny over whether sustainability targets are sometimes set to be easily met.

Beyond the four main categories, the market continues to evolve, with newer instruments such as **Transition Bonds** aligning financing directly with decarbonisation strategies for high-emitting industries.

Climate Transition Bonds: Expanding the universe

For all of the progress the sustainable bond market has made in its first decade, a significant gap remained. Green bonds, social bonds, and their variants were well suited to financing activities that were already clean or already positive. They were far less useful for the sectors where the transition to net zero is most urgent and most difficult: steel, cement, chemicals, oil and gas, aviation, shipping, and heavy transport. These industries account for roughly 40% of global greenhouse gas emissions, yet their complexity, their reliance on existing infrastructure, and the absence of ready-made low-carbon alternatives made it difficult for them to credibly access the labelled bond market at scale.

In November 2025, ICMA addressed this directly by publishing the Climate Transition Bond (CTB) Guidelines, introducing the Climate Transition Bond as a standalone label.[3] The CTB sits alongside the existing four categories rather than replacing any of them, completing a toolkit that had previously lacked a credible instrument for financing industrial transformation.

The purpose of the CTB label is to allow high-emitting issuers to raise capital for genuine transition activities, including some that would previously have sat at the edge of or entirely outside what the market considered investable under a sustainability label.[4] Eligible project categories include carbon capture and storage applied to fossil-based industrial processes, early retirement of high-emission assets such as coal-fired power plants, fuel switching where a credible pathway to low-carbon fuels is built into the design, development of lower-carbon fuels and related infrastructure, and methane and flaring abatement in existing oil and gas operations. Critically, the CTB framework does not lower the bar for heavy industry. It raises it.

Issuers must meet or explain a series of safeguards when selecting projects. They are required to have a credible climate transition strategy into which the funded projects clearly fit. They must demonstrate that no viable low-carbon alternative currently exists to deliver the same outcome. And they must show that their projects are aligned with recognised sectoral decarbonisation pathways and 1.5°C-consistent net-zero trajectories. Where fossil fuel infrastructure is

3 https://www.icmagroup.org/News/news-in-brief/the-executive-committee-of-the-principles-announces-guidance-for-climate-transition-bonds/

4 https://www.icmagroup.org/assets/documents/Sustainable-finance/2025-updates/Climate-Transition-Bond-Guidelines-CTBG-November-2025.pdf

involved, additional requirements apply, including annual independent verification of forward-looking metrics and a commitment to switch to low-carbon fuels within defined timeframes.

The guidelines also introduce an "amber" category to handle the reality that many existing industrial assets are not yet on a 1.5°C pathway but are genuinely moving toward one. Amber activities carry mandatory sunset dates, typically 2030 and in some hard-to-abate cases 2035, after which the activity must either be aligned with the 1.5°C pathway or lose its eligible status entirely. This time-bounded logic is important: it prevents the amber category from becoming a permanent shelter for high-emitting assets and forces issuers to plan for real trajectory change rather than incremental improvement.

For investors, the CTB label does something the market previously lacked: it provides a defensible, standardised basis for holding bonds from high-emitting issuers within sustainability-oriented mandates. The "meet or explain" disclosure structure, combined with the requirement for external review, offers a level of accountability that bespoke due diligence alone could not consistently deliver.

As the world's fourth-largest economy and a major capital exporter, Japan's engagement with the sustainable bond market has historically been more measured than its economic weight might suggest. The publication of the ICMA Climate Transition Bond guidelines in November 2025 changed this materially. Japan is by far the largest issuer of ICMA-aligned transition bonds, channelling substantial capital through a government-backed programme toward industrial decarbonisation. For a market with a significant base of high-emitting industrial issuers and a government committed to both energy security and net zero, the CTB framework provides a credible vehicle that suits the specific character of the Japanese market.

The scale of what the CTB framework is designed to unlock is substantial. An estimated USD 30 trillion of capital is needed to decarbonise the eight highest-emitting industrial sectors by 2050.[5] Climate Transition Bonds will not close that gap alone, but they give the debt capital markets a credible instrument with which to start.

The regulatory backdrop

Policy and regulation have played an increasingly important role in shaping the sustainable bond market, with the European Union (EU) leading the way. The EU Taxonomy[6], which was introduced in 2020 and applied from 2022 onwards, established a common classification system for environmentally sustainable economic activities. EU Sustainable Finance Disclosure Regulation (SFDR) applied from 2021 and introduced mandatory sustainability reporting requirements for financial market participants. The EU Green Bond Standard, which became applicable in December 2024, raised the bar further still, requiring that proceeds be allocated exclusively to EU Taxonomy-aligned activities and imposing stricter third-party verification requirements. Together, these frameworks have done meaningful work in addressing greenwashing concerns and improving disclosure consistency across the market.

The international picture is more complicated. The EU remains the most advanced regulatory environment for sustainable finance, and its frameworks have influenced the approach taken by regulators in the UK, Asia, and parts of Latin America. But a single global standard remains a long way off. In the US, political and legal resistance has slowed the implementation of climate-related disclosure requirements, and there has been a broader retreat from ESG-related regulatory ambition at the federal level. The SFDR itself is currently under review by the European Commission, which is working through a revised framework that has yet to be finalised.

The direction of travel toward greater transparency and standardisation remains the dominant trend, but investors allocating assets across multiple jurisdictions need to navigate a regulatory landscape that is still actively evolving.

The evolution of green bonds across emerging markets

While the template for sustainable bonds has been most credibly established in Europe, emerging market sustainable debt is becoming an increasingly important part of the picture, largely borne from the necessity of addressing climate change across all corners of the world. The infrastructure investment required to support economic development in Asia, Latin America and Africa, while also managing the physical risks of climate change, is enormous. Many of these economies are simultaneously building out energy systems, expanding urban infrastructure and adapting to climate impacts

5 https://www.weforum.org/stories/2024/12/net-zero-transition-requires-a-30-trillion-investment-for-hard-to-abate-sectors/

6 https://finance.ec.europa.eu/sustainable-finance/tools-and-standards/eu-taxonomy-sustainable-activities_en

that are already more severe than those facing most developed economies. The capital required is long-dated and significant, which makes it well suited to bond market financing. Moreover, the use-of-proceeds transparency of green bonds provides an accountability framework that development-focused investors find particularly valuable.

Progress on disclosure and reporting standards has historically been uneven across emerging markets, with data availability and governance frameworks lagging behind the developed market norm. But this gap is narrowing. A number of significant markets have made meaningful strides in aligning their domestic green bond standards with international frameworks. China, which is one of the world's largest green bond markets by issuance volume, has updated its guidelines to align more closely with ICMA's Green Bond Principles, improving the transparency and comparability of Chinese labelled bonds for international investors. Similar alignment has been observed in parts of the Middle East, where sukuk issuance structures have increasingly incorporated green bond reporting standards.

The same logic that has accelerated green bond issuance in Europe is now doing the same across the developing world, compressing what might have been a decade-long transition into a much shorter timeframe. In the first four months of 2026, with oil prices surging, issuance of green bonds from developing countries jumped 53% to $24 billion, the strongest start to a year since the record haul of 2023.[7] The reasoning is sound: renewables offer emerging market governments a faster and cheaper route to energy security than continued dependence on fossil fuel imports.

For investors, these developments matter for two reasons. First, they expand the investable universe of credible, transparent sustainable bonds beyond the European core, reducing concentration risk and broadening the range of impact themes available within a portfolio. Second, they bring new pools of capital into the market, which over time is likely to improve liquidity, deepen pricing and support the continued growth of the asset class globally.

The picture across emerging markets is not uniform, and additional diligence remains essential when assessing issuers in markets where disclosure standards are still developing. But the direction of travel is clear, and the pace of change in some markets is faster than many investors recognise.

From niche to mainstream

What began as an instrument for multilateral development banks has become a genuinely global asset class, spanning sovereigns, corporates and financial institutions across multiple regions, currencies and sectors. The frameworks governing what qualifies have become more rigorous, not less, and the range of instruments available to investors has expanded to cover everything from established green infrastructure to the most challenging corners of the industrial transition.

For investors, sustainable fixed income is a substantial, liquid and increasingly well-understood market that can offer access to the growing capital flows reshaping the global economy. The themes driving issuance, energy security, digital infrastructure, climate adaptation and industrial decarbonisation, are the same themes driving long-term investment returns. The investment case is straightforward. For investors looking to capture the trends driving returns today and shaping the markets of tomorrow, sustainable fixed income opportunities are worth considering.

The next chapter looks at how a shifting geopolitical landscape, and the arrival of artificial intelligence (AI) at scale, have dramatically shifted investor priorities and caused the very concept of 'sustainability' to be redefined. It also examines how, in a more fragmented and uncertain macroenvironment, the investment case for green bonds has become even stronger.

7 https://www.bloomberg.com/news/articles/2026-05-06/green-bond-deals-surge-in-emerging-markets-to-mitigate-oil-shock?embedded-checkout=true

Chapter 2

Sustainability in an age of geopolitical risk

Sustainability in an age of geopolitical risk

When the first edition of this guide was written (2023), green bonds were a growing force in fixed income markets, but the investment case focused primarily on the need to limit global warming, fund the energy transition and meet net zero targets. That investment case remains valid, but the broader picture has become more complex.

Supply chain disruption, fragmented global trade, and the weaponisation of energy as a geopolitical tool have changed how governments, companies and investors think about where energy comes from and how reliably it can be accessed. At the same time, the rapid expansion of AI and the digital infrastructure required to support it has increased electricity demand and looks to be reshaping energy systems from the ground up.

In this landscape, the transition to cleaner, domestically-produced energy has evolved from purely an environmental objective towards an economic and strategic necessity.

Europe's energy vulnerability

Despite making steady progress on decarbonisation, Europe as a whole still imports more than half of its energy[8], leaving it exposed whenever supply is disrupted. That exposure became impossible to ignore during the 2022 energy crisis that followed Russia's invasion of Ukraine, when wholesale gas prices rose to more than ten times their long-term average at the peak. The effects fed quickly through the economy, driving inflation, eroding industrial competitiveness and placing severe pressure on public finances. Governments responded with large-scale support measures, adding further strain to already stretched balance sheets.

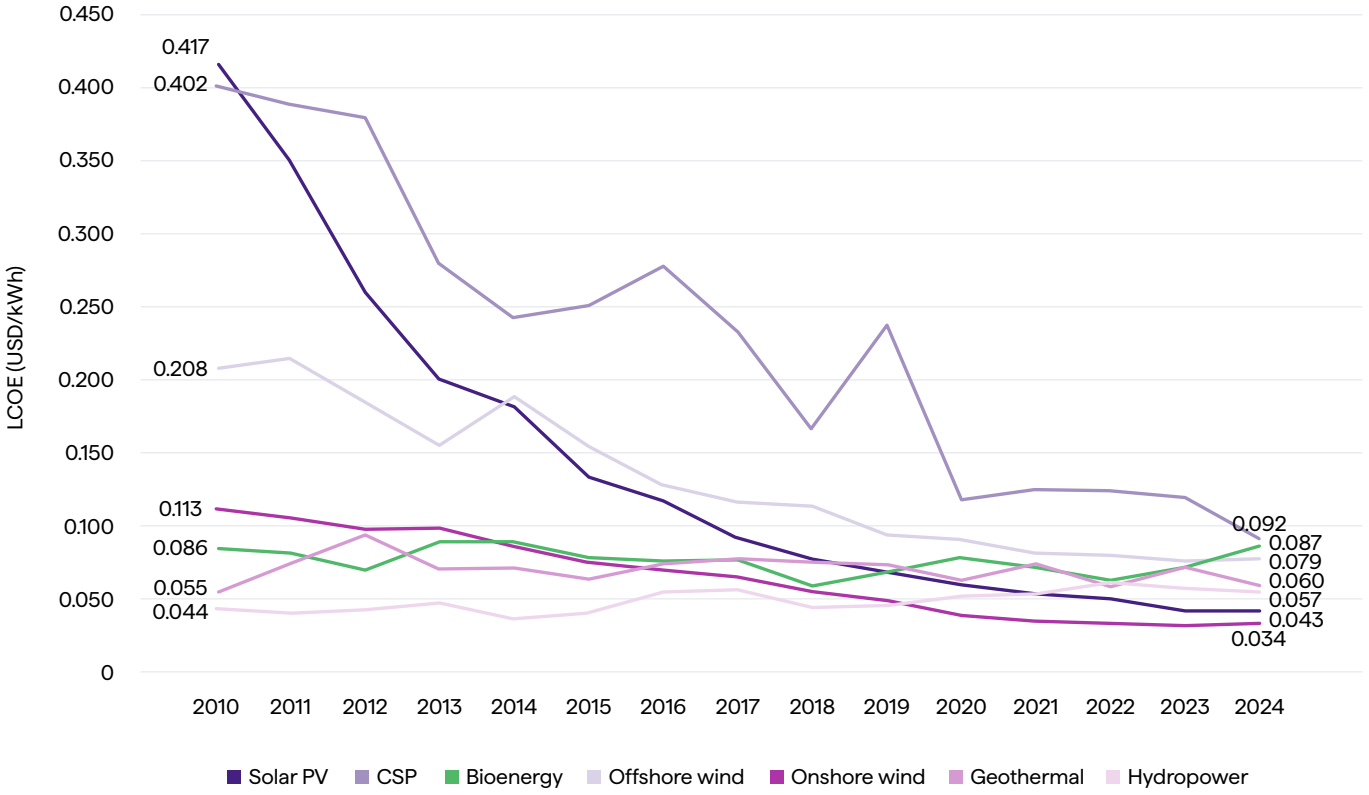
The experience brought home the size of the challenge. While reducing emissions remains a priority for the region, energy independence has become equally significant, and has started to drive policy decisions and investment flows across the continent. Projects that might previously have faced slower permitting or fragmented policy support are moving more quickly through approval processes. Fiscal support is becoming more consistent, and private capital is being drawn in at greater scale. Energy diversification has become part of the economic infrastructure necessary to support stability and growth.

The scale of investment required is considerable. Recent estimates suggest Europe may need to invest more than EUR 600 billion a year in energy infrastructure through to 2030 to meet its climate and security objectives.[9] Renewables are emerging as the most practical route forward, and not only for environmental reasons. Solar PV utility-scale generation now costs around USD 58 per MWh, and onshore wind approximately USD 62 per MWh, compared with USD 147 per MWh for coal and USD 180 per MWh for gas peaking, according to Lazard's 2025 LCOE analysis. The economics are no longer marginal. Renewables are the cheapest option available at scale, which means the energy security argument and the investment case are pointing in the same direction.

8 https://energy.ec.europa.eu/news/focus-eu-energy-security-explained-2026-04-20_en

9 https://energy.ec.europa.eu/news/commission-launches-strategy-accelerate-clean-energy-investment-2026-03-10_en

Chart 1 Levelised cost of energy: a growing advantage for renewables



Notes: CSP = concentrated solar power; kWh = kilowatt hour; LCOE = levelised cost of electricity; PV = photovoltaic; USD = United States dollar Source: International Renewable Energy Agency: Renewable Power Generation Costs in 2024 report

The US: a market in retreat, and what that means

The picture in the United States is markedly different. The US is an energy exporter, largely insulated from the supply vulnerability that has driven Europe's urgency. It does not face the same structural pressure to accelerate a domestic green transition for reasons of energy security, and the political environment since 2025 has moved sharply against ESG-related investment frameworks.

The practical consequence for the green bond market has been swift. US issuance, which had been a meaningful component of global sustainable bond supply, has effectively collapsed. New ICMA-aligned green bond issuance from the US has contracted sharply, with almost all new supply now coming from Europe. The global green bond index is becoming increasingly euro-denominated as a result, adding approximately 5% of additional euro exposure each year as dollar-denominated bonds mature and are not replaced.

For investors in the green bond market, this has two implications worth understanding clearly. The first is that the market's geographic composition is shifting in a way that creates natural currency diversification relative to broader investment grade benchmarks. The global investment grade market remains approximately two-thirds dollar-denominated. The green bond market is moving in the opposite direction, toward two-thirds euro exposure and growing. For investors concerned about dollar weakness, or who are already heavily exposed to US credit through passive allocations, this is a meaningful structural difference.

The second implication is more nuanced. The withdrawal of US political support for green investment has created a pricing dynamic in the US market that works in favour of investors willing to look beyond the label. ESG aversion within parts of the US has pushed some green bond prices down and yields up, generating a relative value opportunity that we explore in more detail in Chapter 5.

What the US situation also underlines is that the momentum behind sustainable fixed income is no longer dependent on any single political environment.

Europe and Asia are pressing ahead regardless of what happens in Washington. The drivers of green bond issuance, energy infrastructure needs, regulatory frameworks, institutional investor demand and the simple economics of renewable energy, are robust enough to sustain the market's growth trajectory without US participation.

The Middle East: Disruption as a catalyst for change?

As home to some of the world's most significant oil and gas reserves and critical shipping chokepoints, including the Strait of Hormuz, the Middle East region sits at the intersection of energy security and geopolitical risk in a unique way. Disruption to energy flows through these corridors affects not just importing nations but the producing economies themselves, through volatile revenues, complicated planning horizons and increased pressure on infrastructure.

However, the same geopolitical pressures that expose the vulnerability of fossil fuel dependence are strengthening the strategic case for renewables, storage, water security and grid resilience. For Middle Eastern nations, utilities and energy companies, sustainability bonds are now an important funding tool for economic stability and long-term security.

The numbers reflect this shift. S&P Global expects Middle East sustainable bond issuance to reach between USD 20 billion and USD 25 billion in 2026[10], with green projects remaining dominant and sustainable sukuk and transition bonds all gaining ground. The United Arab Emirates and Saudi Arabia are expected to lead this growth, with projects spanning solar capacity, grid upgrades, clean water infrastructure and transition activity in hydrocarbon-heavy economies. For investors, the Middle East represents a growing and differentiated source of sustainable bond supply, one that ties directly to the energy security themes reshaping the global investment case.

China's leadership in power production

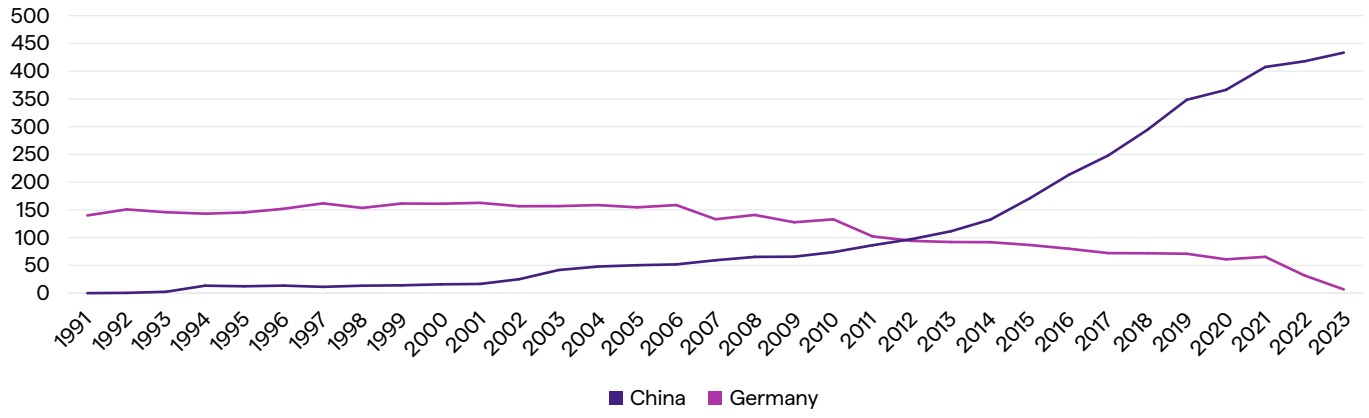
Any discussion of electricity demand must consider China. As living standards rise and industrial capacity expands, its long-term energy needs will continue to grow. The transition away from coal toward renewables therefore represents one of the largest decarbonisation opportunities in the global system.

China's approach to power generation also illustrates how quickly national strategies can shift when energy security and economic priorities align. Nuclear power is a clear example. After beginning to scale capacity around the turn of the century, China accelerated development sharply after 2010. By 2024, its nuclear output had reached roughly 450TWh, more than three times Germany's peak generation before its phase-out. Germany's withdrawal from nuclear followed post-Fukushima politics. China faced different pressures, seeing nuclear as a way to strengthen energy independence and support its industrial strategy. The result is a power system undergoing rapid diversification.

Alongside nuclear, China continues to add record volumes of solar and wind capacity each year, even as it builds new coal plants to meet short-term demand and

10 https://www.arabnews.com/node/2633326/business-economy

Chart 2 Electricity Generation from Nuclear (TWh)



Source: Amova AM, EIA Sep 2025

stabilise the grid. This combination highlights the global challenge: countries are trying to expand low-carbon power at speed while maintaining economic growth. For investors, it reinforces the scale of the infrastructure build-out required worldwide and the importance of financing tools that can accelerate renewable deployment without adding fiscal strain.

The digital transformation era: AI and the new energy reality

Alongside geopolitical risk, a second structural force is reshaping global energy demand. AI is now shaping the global economy at a speed that extends far beyond software. It depends on a vast physical infrastructure spanning computing, data and power, each expanding at a pace that is already testing existing capacity. The biggest bottleneck is not processing power or data storage, but electricity.

After two decades of essentially flat demand, global electricity consumption is projected to rise by more than 40% over the next decade, driven by AI, digitalisation and new forms of industrial production.[11] McKinsey suggests supporting global AI workloads alone may require approximately USD 5.2 trillion in capital expenditure by 2030, much of it from the large technology companies, known as hyperscalers, that are already expanding their data centre networks rapidly.[12]

Meeting this surge in demand will require a sixfold increase in the rate at which new power generation and transmission capacity is built.[13]

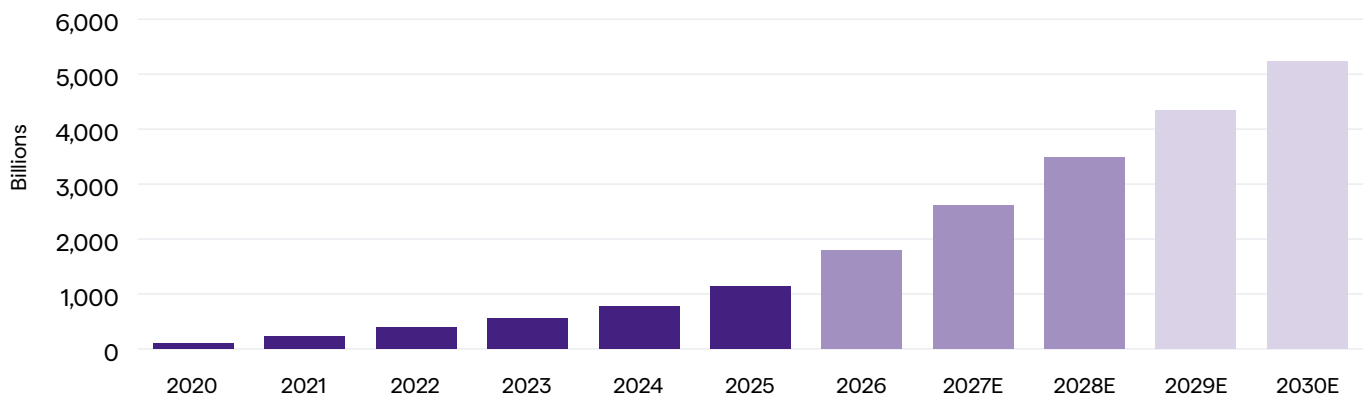
The capital required to build the renewable generation capacity, grid upgrades and storage infrastructure that digital economies depend on is large, long-dated and suited to debt financing. Green bonds, with their use-of-proceeds discipline and direct link to underlying infrastructure assets, are one of the most practical tools for directing that capital at the scale and speed the transition now requires.

The shift is already underway. AI-related debt already accounts for around 13% of the global investment grade index, up from approximately 6% in 2020, and that proportion is projected to reach close to a third of the index by the end of the decade.[14] For investors relying on passive global credit allocations, this represents a growing concentration in the debt of a relatively small number of large US technology companies, carrying downside risk without the equity upside that the AI growth story actually offers.

The shift in capital flows is not limited to Europe. Japan, the world's fourth-largest bond market and a major capital exporter, is also moving. The publication of the ICMA Climate Transition Bond guidelines in November 2025 unlocked a significant new source of sustainable bond supply, with Japan emerging as the largest issuer of ICMA-aligned transition bonds. For a market with a substantial base of high-emitting

11 https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai
12 https://www.mckinsey.com/industries/technology-media-and-telecommunications/our-insights/the-cost-of-compute-a-7-trillion-dollar-race-to-scale-data-centers
13 Source: "AI infrastructure meets energy reality: why green bonds are critical," Amova Asset Management, 12 February 2026.
14 Source: Amova AM, Bloomberg, as of October 2025. (taken from Citywire presentation)

Chart 3 Hyperscalers cumulative capital expenditures 2020-2030



Source: Bloomberg BEST estimates, 2026.

industrial issuers and a government committed to both energy security and net zero, the CTB framework has provided a credible vehicle for directing long-term domestic capital toward the energy transition.

Combined with China's progressive alignment of its own green bond standards with ICMA principles, the world's second and fourth-largest economies are now more meaningfully engaged with the global sustainable bond market than at any point in its history. The pool of capital available to the asset class is growing, and it is growing in markets that are structurally committed to the transition regardless of events elsewhere.

A broader investment story

What was once primarily a response to climate ambition is now also a response to energy security, economic resilience and the electricity demands of a digital economy. These drivers operate independently of any single political environment and are all running simultaneously across the world's major economies. For investors, the implication is straightforward. The capital flows reshaping the global economy are flowing toward the same assets that green bonds finance. The next chapter examines why fixed income is the natural vehicle for directing that capital at the scale and speed the transition now requires.

Chapter 3

Fixed income as the backbone of financial system resilience

Fixed income as the backbone of financial system resilience

The energy transition, the demand for digital infrastructure and the shift toward more resilient economic systems are usually framed as equity stories. The companies developing renewable energy, constructing data centres and upgrading power grids are growth businesses, and growth businesses attract equity capital. But equity is the wrong lens for understanding where most of the capital actually needs to go. The physical systems that modern economies depend on are not built on the logic of venture returns. They are long-dated, capital-intensive and generate stable, predictable cash flows over extended time horizons. These are the characteristics that more adequately define debt financing, rather than equity.

Why debt, not equity, finances infrastructure

Equity rewards risk-taking and is therefore a natural home for capital prepared to accept volatility in exchange for the possibility of significant returns. The physical systems that societies depend on operate on a different logic entirely. Electricity grids, water networks, transport links, storage facilities and the data infrastructure underpinning the digital economy are not high-risk growth assets. They are essential services with long asset lives, regulated or contracted revenues, and financing needs that extend decades into the future. Debt is the instrument designed for just this kind of asset.

This has a direct implication for how to think about some of the largest capital expenditure programmes currently under way. The build-out of AI infrastructure is a case in point. Data centre capex is projected to reach USD 5.2 trillion by 2030, and much of this will be debt-financed. AI-related debt already accounts for around 13% of the investment grade index, up from approximately 6% in 2020, and that proportion is likely to continue rising. But does owning this debt make sense for investors? It depends on your reasons for owning it, and for most investors, the case for holding AI-related debt is weaker than it might appear.

The case for diversifying AI exposure

For investors seeking exposure to the AI theme, the question is where in the capital structure does that exposure make the most sense. The upside of AI, if the technology delivers on its promise, accrues primarily to equity holders. The debt issued to fund the infrastructure carries the downside risk without the corresponding upside participation.

It is worth noting that the debt being issued by the major technology companies to help fund AI infrastructure is, almost without exception, conventional unlabelled corporate debt. The hyperscalers are not issuing green bonds. Investors who hold this debt through passive index exposure receive no use-of-proceeds transparency, no direct link to the underlying assets being financed, and no sustainability benefit. They are simply lending money to large technology companies at a fixed rate, with all the downside risk that entails if the AI growth story disappoints.

Green bonds, by contrast, finance the energy infrastructure that the hyperscalers depend on but do not control. The utilities, grid operators and renewable energy providers that supply power to data centres provide services that are likely to remain in demand irrespective of what happens to the technology companies consuming that power. Energy demand is unlikely to disappear if an AI company misses its revenue targets, faces regulatory intervention or

struggles under the weight of its own debt. In that sense, sustainable fixed income offers investors exposure to the infrastructure layer that underpins AI, without the concentration risk that comes with owning hyperscaler debt directly.

For investors already carrying significant AI-related dollar debt exposure through passive allocations, green bonds are not just a diversifier, but could be considered a meaningful hedge.

Portfolio diversification in practice

The diversification argument for sustainable fixed income operates on several levels simultaneously. At the credit level, the green bond market provides exposure to issuers and sectors that look meaningfully different from a passive investment grade benchmark. Utilities, as seen in Chart 1 for example, have one of the lowest default rates of any sector in the investment grade universe, both historically and in recent years. Including them as a core allocation may reduce concentration risk relative to a market that is increasingly weighted toward technology and financial sector debt.

At the currency level, the divergence between the green bond market and the broader investment grade universe is becoming more pronounced. As discussed in Chapter 2, the global investment grade market is approximately two-thirds dollar-denominated.

The green bond market is moving toward two-thirds euro exposure and growing, as US issuance has effectively withdrawn from the market. For investors who are already heavily exposed to dollar assets through passive allocations, or who have concerns about the trajectory of the dollar under current US policy, this represents a structural source of currency diversification that does not require an active currency overlay to access.

At the duration level, sustainable fixed income portfolios tend to carry longer duration than many traditional credit benchmarks. In periods of geopolitical volatility, duration has historically served as a hedge, with government and high-quality bond prices rising as investors move toward safety. The long-dated nature of infrastructure assets suggests that green bonds naturally carry this characteristic, providing a degree of portfolio ballast that shorter-duration credit cannot.

Why fixed income is key to financial system resilience

The energy transition, the build-out of digital infrastructure and the broader shift toward more resilient economic systems all share a common characteristic: they require large amounts of long-term capital, deployed into physical assets, at a scale and pace that equity markets alone cannot sustain. Fixed income is the natural vehicle for this kind of financing. And within

Chart 1 Global corporate default rates by industry (percentage)

Industry	2025	2024	Weighted average (1981-2025)	Median	Standard deviation	Minimum	Maximum
Insurance	0.12	0	0.23	0.12	0.86	0	4.76
Utility	0.35	0.35	0.43	0.18	0.73	0	4.52
Financial institutions	0.46	0.55	0.61	0.44	0.65	0	2.68
Transportation	0.71	1.77	1.97	1.77	1.56	0	6.19
Real estate	1.22	0.91	0.84	0	2.51	0	12
Energy and natural resources	1.29	1.08	2.97	1.66	2.81	0	13.73
Aerospace/automotive/capital goods/metal	1.46	2.49	2	1.42	1.86	0	9.36
High tech/computers/office equipment	1.78	2.34	1.22	0.97	1.36	0	4.79
Leisure time/media	1.96	4.99	3.38	2.22	3.1	0	16.88
Forest and building products/homebuilders	2.21	3.49	2.37	1.54	2.82	0	15.1
Consumer/service sector	2.97	3.2	2.46	1.89	1.57	0	6.24
Telecommunications	3.31	4.97	2.54	1.12	3.43	0	17.9
Health care/chemicals	4.13	4.51	1.76	0.96	1.43	0	4.58

Source: S&P Global, 2026.

fixed income, sustainable bonds, with their use-of-proceeds discipline, their transparency requirements and their direct link to the assets being funded, are particularly well suited to the task.

For investors, the events of the past few years have shown that stability cannot be taken for granted. Genuine portfolio resilience requires more than diversification across assets that move together in a crisis. Green bonds that finance essential infrastructure, are long duration, and provide transparency over what capital is funding, can play a valuable role in portfolios, by offering return potential that is not dependent on a single political environment, a single currency or a single technology cycle.

The next chapter looks at where that capital is being deployed today and what it is financing in practice.

Chapter 4

Where sustainable fixed income is deployed today

Where sustainable fixed income is deployed today

Understanding how and where green bond capital is deployed is one of the most important questions an investor can consider. This chapter looks at the three key areas where sustainable fixed income is being deployed most meaningfully today, followed by real-world examples of issuers putting capital to work.

1. Energy security and system resilience

Since the early days of green bonds, energy – including power generation, grid modernisation, storage and electrification – has been the single largest destination for green bond capital. But as discussed in this guide, while reducing carbon emissions remains a central imperative, it is no longer the sole driver, as the need to build more resilient, secure and domestically supplied energy systems has become increasingly critical, and the numbers involved are substantial.

As outlined in Chapter 2, Europe alone may need to invest more than EUR 600 billion a year in energy infrastructure through to 2030. European utility companies have been among the most active issuers in the green bond market and in our view are well positioned to finance this build-out. EDF currently has EUR 16 billion in green bonds outstanding, targeting 60GW of renewable capacity by 2030 with 85% of its green financing aligned with the EU Taxonomy. Iberdrola has EUR 22.9 billion outstanding, targeting 60 GW of low-carbon capacity including nuclear and renewables, with a net zero commitment by 2050. Orsted has EUR 15 billion outstanding and plans 50GW of installed capacity by 2030, spanning offshore wind, solar and battery energy storage systems.[15] These represent some of the largest infrastructure investment programmes in Europe, financed substantially through the green bond market, and directly relevant to the energy security priorities discussed previously in Chapter 2.

Of course, not all utility green bonds offer the same opportunity. Active investors in this area are looking for issuers with a lower current share of renewable generation but have a credible plan to increase it. As their energy mix improves, so should their credit quality, since renewables now cost materially less to operate than conventional generation. Identifying these issuers early – before the market prices in that trajectory – is one of the more distinctive ways active management can add value in this theme.

Spotlight issuer:

Ørsted

Few corporate transformations in the energy sector have been as complete, or as consequential, as Orsted's. Fifteen years ago, the Danish company was one of Europe's most carbon-intensive power generators, heavily reliant on coal. Today it is the world's leading offshore wind developer, with 18.5GW of installed renewable capacity and a renewable energy share of 99%. In 2024, it closed its last coal-fired plant.[16]

15 Amova AM research.

16 Orsted Green Finance Impact Report 2025.

Hornsea One, Ørsted's offshore wind farm in the North Sea off the Yorkshire coast, launched in 2019 as the world's largest offshore windfarm, delivering 1.2 GW of renewable power to more than a million UK homes.

Source: Ørsted'

That transformation was financed substantially through green bonds. Since issuing its first green bond in 2017, Orsted has committed to using only sustainable instruments for long-term financing. Green bonds now account for 88% of its total outstanding bond portfolio, with DKK 79.5 billion currently outstanding across 22 bonds. Since 2017, total allocated proceeds have reached DKK 83.2 billion, directed to 24 renewable energy projects spanning offshore wind, onshore wind, solar power, and battery energy storage systems across Europe, Asia Pacific, and North America.

What makes Orsted relevant as a case study is not just the scale of its transition but the discipline behind how it has been financed. Every project is aligned with the EU taxonomy, and the company's Green Finance Framework has received the highest possible rating from S&P Global Ratings. Orsted also goes beyond carbon in its sustainability commitments, with a stated ambition to deliver net-positive biodiversity impact from all projects commissioned from 2030, and a Biodiversity Measurement Framework to support that goal.

Orsted has faced genuine challenges in recent years, including project cancellations and a period of significant share price pressure. But unlike companies that have made environmental commitments and then retreated, Orsted has continued to build. The underlying transformation is real, and the green bond programme has been a central tool in making it happen.

2. Promoting the circular economy

Most investors associate green bonds with renewable energy projects or green buildings, but the circular economy tells a different story. It focuses on closing resource loops, reducing waste, managing land responsibly and financing the infrastructure that keeps materials in productive use rather than sending them to landfill.

This matters for investors because it widens not just the opportunity set, but also the range of environmental outcomes financed through green bonds. Circular economy projects introduce impact themes such as waste reduction, resource efficiency, water, pollution prevention and natural resource conservation, extending the market beyond the areas most commonly associated with green bond issuance.

The circular economy is therefore less a niche within green bond finance and more evidence of how far the market has evolved. Recognised use-of-proceeds frameworks already support investments in areas such as waste management and resource efficiency, provided issuers clearly identify eligible projects, track the use of proceeds and report on outcomes.

It also opens up green bond issuance to a broader range of sectors and business models than the energy transition alone, giving investors access to a more diversified set of credits and impact themes. This breadth reflects the expanding scope of green bond finance rather than as a special case within it.

Spotlight issuer:

Smurfit Westrock

Most green bonds finance things that are easy to recognise as green: wind farms, solar panels, electric buses. Smurfit Westrock, now one of the world's leading paper-based packaging companies, is a reminder that the circular economy can be just as important to environmental outcomes, and that

packaging, of all things, can be a meaningful vehicle for sustainable finance.

Smurfit Westrock operates in 40 countries with around 100,000 employees and a paper and board capacity of approximately 23 million tons per annum. Its green bond portfolio stands at $5.9 billion. Smurfit Westrock's green bonds finance two things: the circular production process itself, from collecting used paper through recycling, milling and packaging conversion, and the responsible management of its certified forests, which cover more than 120,000 hectares globally.

A USD 30 million upgrade at Smurfit Westrock's Solvay mill in New York has enhanced wastewater treatment and recycling, reducing environmental impact. By converting organic waste into biogas, the facility now offsets fossil fuel use and lowers emissions, illustrating how industrial infrastructure can be modernised to support circular production processes.

Source: Smurfit Westrock 2025 Sustainability Report.

What makes this issuer interesting is what the numbers behind that production process look like. In 2024, the company consumed approximately 14 million tons of recovered fibre, with 56% of its global production coming from recycled sources. Waste sent to landfill has fallen by 48.5% across Smurfit Kappa's paper mills since 2013, and by 24% across WestRock's operations since 2019. Carbon emissions have followed a similar direction, with both legacy businesses reducing scope 1 and 2 CO2 by around 15% against their respective 2019 baselines.

For investors, Smurfit Westrock is a useful illustration of how the circular economy creates green bond opportunities in sectors that would not normally appear on a sustainable investment shortlist. The packaging industry is not going away, so the question is whether the capital financing it is directed toward companies that are genuinely closing resource loops, or those that are not.

3. Natural capital, food and water security

The third deployment theme is the newest and in many ways the most significant in terms of where the market is heading. Natural capital encompasses the ecosystems, water systems, soil quality, biodiversity and food production capacity that underpin economic activity across every sector. The risks associated with their degradation, crop failures, water scarcity, supply chain disruption and social instability, are increasingly being recognised as financial risks as much as environmental ones.

This is an area where green bond issuance is still developing. Sovereigns and supranationals have led the way, financing adaptation measures, flood defences, sustainable agriculture and water infrastructure. Corporate issuance in this space remains limited but is growing as the regulatory environment evolves and as investors begin to price nature-related risk more explicitly into credit analysis.

The investment case here operates on a longer horizon than energy transition. But the underlying logic is the same: the capital required is large, long-dated and suited to debt financing, and the use-of-proceeds discipline of green bonds provides the transparency that investors need to assess real-world impact.

Spotlight issuer:

NWB BANK

With nearly 70% of the Netherlands living in areas below sea level and four major European rivers flowing through the country, water management is not an environmental policy choice but a matter of national survival. Nederlandse Waterschapsbank, (NWB Bank), which is wholly-owned by the Dutch state and local authorities, is the government's primary financing partner for sustainability infrastructure, channelling capital to the water authorities responsible for keeping the country safe, liveable and ecologically intact.

NWB Bank issues Water Bonds, with the proceeds directed exclusively towards water-related projects including flood defence, climate adaptation, and restoring ecosystems and waterways, as well as other initiatives aligned with the EU Taxonomy. Its reporting is transparent and detailed, with an annual Water Bond Report covering eligible loans, project examples,

taxonomy mapping and environmental impact assessments.

Rather than financing a reduction in future emissions, NWB Bank's financing is oriented towards managing physical climate risks that are already unfolding. As discussed in Chapter 2, adaptation is an underappreciated dimension of sustainable investing: even under ambitious decarbonisation pathways, substantial capital will be required to safeguard assets, maintain resilient infrastructure and protect communities from unavoidable climate impacts.

Kornwerderzand is a sluice and lock complex on the Afsluitdijk, originally built in the early 1930s and now being upgraded to help manage water levels and protect the Netherlands from flooding as sea levels rise. Projects of this kind are representative of the flood protection and water management infrastructure financed by Dutch water authorities through NWB Bank's Water Bonds.

Source: Shutterstock

From a credit perspective, NWB Bank's government ownership and AAA rating place it at the lower end of the risk spectrum, making its Water Bonds an accessible entry point into nature and biodiversity finance for investors seeking both impact and stability.

Spotlight issuer:

BTP Green

While NWB Bank illustrates what specialist sovereign institutions can finance, Italy's BTP Green programme shows what a national government can do when the full weight of a state budget sits behind the framework. Since its first issuance in 2021, Italy's BTP Green programme has raised a total of EUR 46.78 billion across four bonds, with EUR 11.5 billion raised through 2024 issuances alone.[17] The proceeds are allocated against eligible expenditures in the state budget across six categories: renewable energy, energy efficiency, transport, pollution prevention and the circular economy, environmental protection and biodiversity, and research.

The breakdown of that spending tells a different story to the typical corporate green bond. Transport accounts for the largest share at 40.5%, directed primarily at railway infrastructure, electrification of rail lines, new high-speed routes, metro construction and electric bus procurement. Energy efficiency in buildings follows at 34.9%. But what makes the BTP Green programme distinctive for investors thinking about diversification is the remaining categories. These include:

- Environmental protection and biodiversity (9.1%), includes national parks maintenance, protecting wildlife and combating environmental crime.
- Research (5.6%) directed to institutions including the National Agency for New Technologies, Energy and Sustainable Economic Development
- Pollution prevention (8.7%), particularly around preventing wildfires, as well as financing waste management, water monitoring and purification initiatives

Rome has begun rolling out more than 400 electric buses, with deliveries through 2026 as part of a wider fleet renewal aimed at reducing emissions and modernising public transport.

Source: Sustainable Bus (sustainable-bus.com)

When a sovereign issues green bonds, it can direct capital across the entire spectrum of public expenditure, including areas that generate no

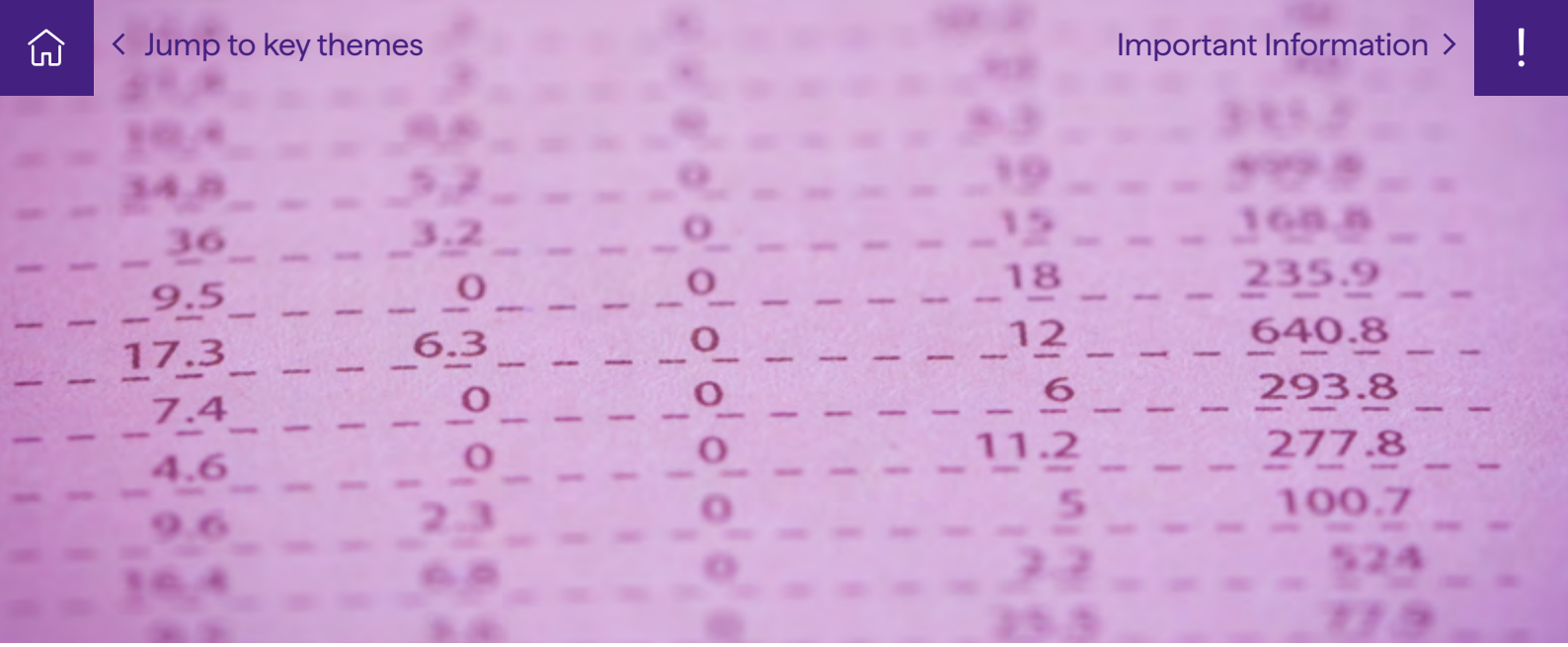
17 Allocation and Impact Report – BTP Green (2025)

commercial return and that the private sector has little incentive to fund. For investors in diversified green bond funds, sovereign bonds like Italy's BTP Green offer exposure to the full breadth of environmental expenditure, not just the categories where private capital naturally flows.

The underlying thread

Across these three themes, a common thread becomes apparent: from governments and supranationals to major corporates across a wide range of sectors and geographies, green bonds are being used to finance projects that are capital intensive, long-dated, and central to the functioning of modern economies. Moreover, the use-of-proceeds framework that defines green bonds provides investors with a level of transparency about where their capital is going that is simply not available in conventional fixed income. This transparency helps green bond investors to assess impact, engage meaningfully with issuers and make informed decisions about where sustainable fixed income fits within a broader portfolio.

The next chapter examines one of the most debated questions in sustainable fixed income: whether investing in green bonds comes at a cost to returns, and what the evidence actually shows.



Chapter 5

Rethinking the greenium

Rethinking the greenium

One of the most common objections to investing in green bonds has always been the 'greenium' – the belief that investors must accept a lower yield for choosing a green bond over a conventional equivalent. For years, this was treated as an established fact of the market, the cost associated with the sustainability label. However, our latest research suggests the picture looks more nuanced.

In the early years of the green bond market, a greenium did exist. Supply of green bonds was limited, demand from ESG-focused investors was concentrated, and prices reflected that imbalance. But as the market has grown and diversified, the assumption that investors must sacrifice yield has become increasingly difficult to support. The question is not whether the greenium once existed, but whether it still does, and if so, where.

A broader examination of the bond market

Most research into the greenium has been methodologically narrow. A notable recent study examined around 3,500 bonds, focused exclusively on euro-denominated investment grade debt, and covered only the last three years of market data. Conclusions drawn from a sample that is constrained in scope risk reflecting the parameters of the study as much as the market itself.

Our research team took a different approach. Using ICE index data covering the entire USD 70 trillion global bond market, our team built a dataset of approximately 2.1 million observations collected on a monthly basis from 2017 onwards. The dataset spans multiple currencies, with EUR-denominated bonds accounting for around 60% and USD bonds around 20%, with GBP, AUD and CAD making up most of the remainder. Over that period, green bonds have grown from around 1.5 to 2% of the total market to approximately 9 to 10% today.

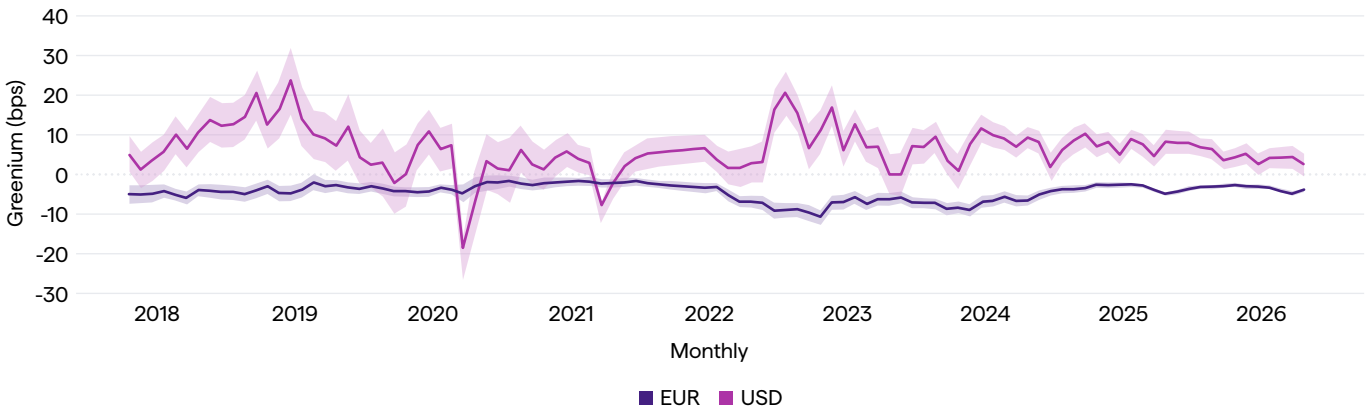
Rather than looking at the market as a single aggregate, our research examined the cross-section of data across currencies, sectors, ratings and time periods. The result is a model with a significantly better statistical fit than prior studies, explaining around 75% of the variation in spreads compared to approximately 25% for the narrower approach.

What the research shows

Our findings challenge the conventional view of the greenium in two important ways. In our research we have found that within EUR-denominated markets comparable to or higher than conventional equivalents, rather than the lower yields that a greenium assumption would suggest. Also, where a modest premium has emerged in Europe, it appears concentrated in the period from 2023 onwards and is likely linked to broader market conditions, including higher volatility, longer duration positioning and the quality premium that green bonds generally attract in periods of stress, rather than reflecting a structural feature of the green bond market itself.

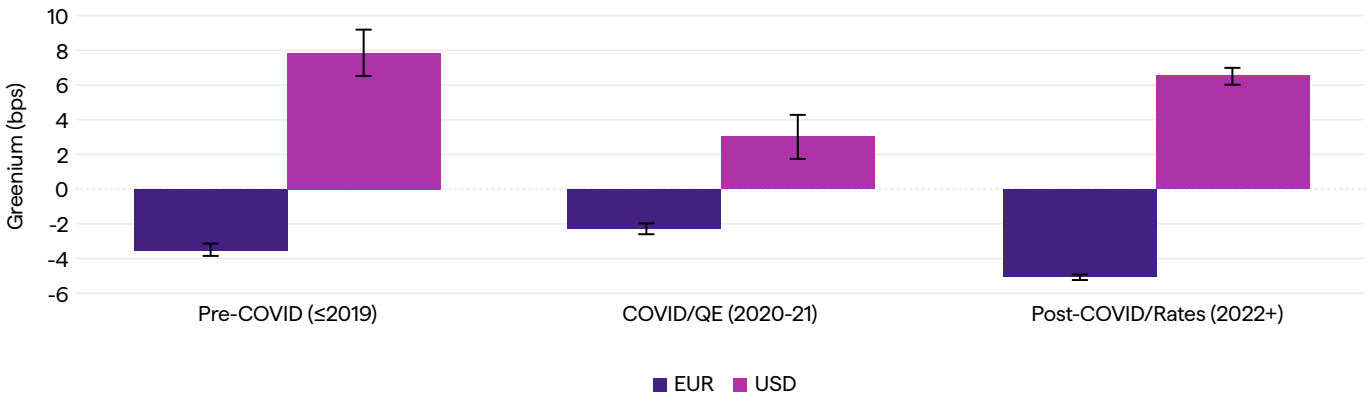
For the USD market, the picture is clearer. Our research finds green bonds in the US have consistently offered investors higher yields than traditional equivalents across the study period. Investors have not been paying more for the sustainability label, and in many cases, they have been paid more for holding it, perhaps between five and ten basis points per year (Chart 1, 2).

Chart 1 Greenium by month and currency (negative values indicate higher prices or lower yields for green bonds)



Source: Amova Asset Management, ICE Data 2026

Chart 2 Greenium by regime period and currency – Amova AM Model (negative values indicate higher prices or lower yields pricing for green bonds, ±1 standard error)



Source: Amova Asset Management, ICE Data 2026

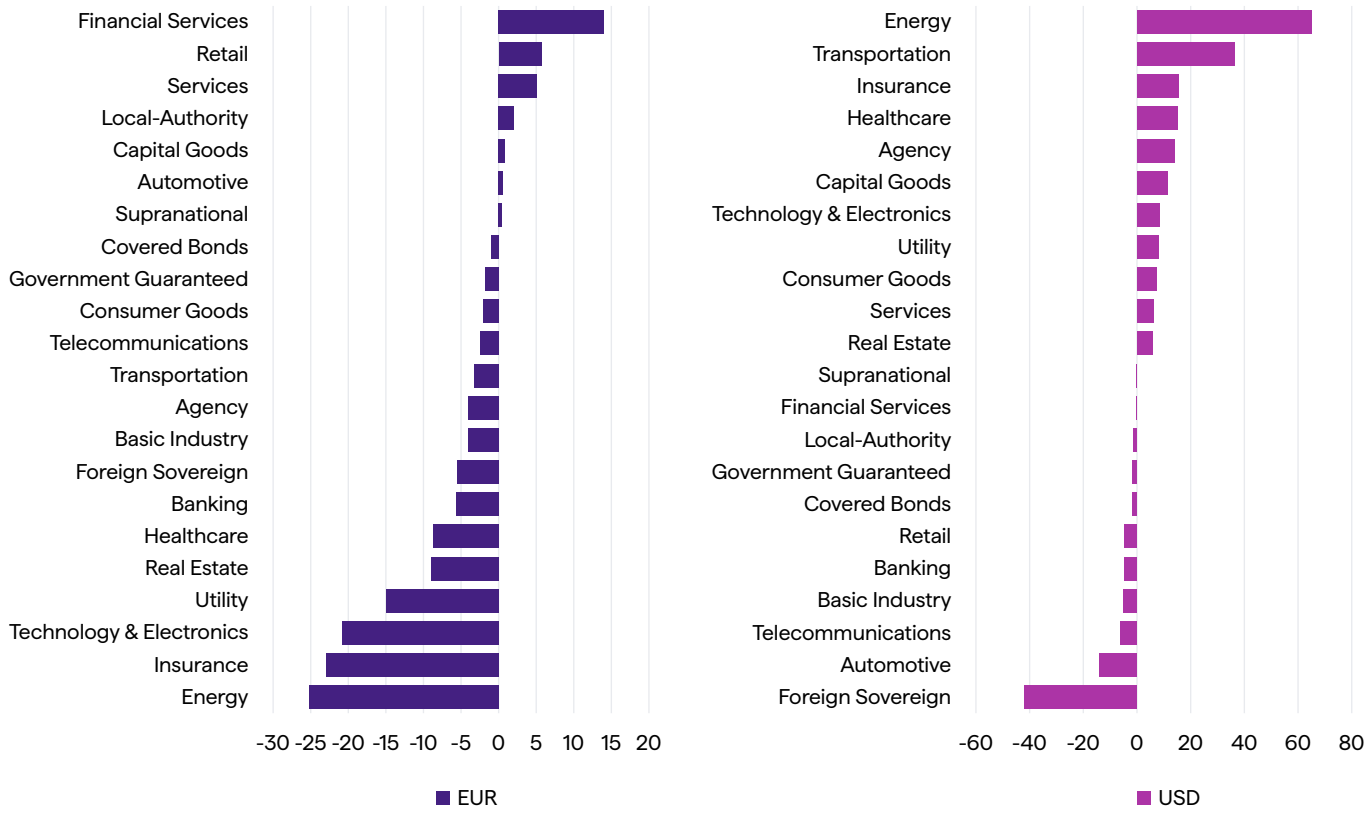
What earlier studies missed

Many of the pricing differences associated with green bonds may actually reflect broader bond characteristics rather than the green label itself. Green bonds are often issued by higher-quality borrowers and therefore tend to carry lower coupons, while lower-quality issuers generally need to offer higher coupons and wider spreads to attract investors. Green bonds also tend to have longer durations, which naturally leads to wider spreads because investors are exposed to interest rate and inflation risks for longer. Other factors, such as convexity, liquidity and volatility, also play an important role in pricing.

The distribution of green bond ratings across the market is broadly similar to conventional bonds, spanning the full range from triple-A to triple-B, so ratings alone do not explain the pricing differences observed. A further control variable in the research is bond richness: bonds that are already trading expensively relative to their fundamental value tend to have tighter spreads, and accounting for this separates the green label effect from temporary pricing anomalies.

Overall, once these structural factors are taken into account, evidence for a consistent green premium becomes much weaker. The model explaining around 75% of spread variation suggests that most of what has historically been attributed to the green label is better explained by the underlying characteristics of the bonds themselves.

Chart 3 Greenium by industry (negative values indicate green bonds trade at tighter spreads)



ource: Amova Asset Management, ICE Data 2026

Sector variation matters

Even within these broad regional findings, the picture varies meaningfully by sector. In Europe, investors in utilities, insurance and telecommunications have tended to receive lower yields on green bonds than their conventional counterparts, with utilities being the most pronounced. In the US, investors in energy, transportation and insurance have tended to receive higher yields on green bonds than on conventional equivalents.

The practical implication is that any difference in yield associated with the green label is neither uniform nor unavoidable. Investors who understand the sector dynamics can therefore position their bond portfolios to minimise any residual pricing differential and in many cases benefit from it.

Turning variation into active returns

The variation in the greenium across different sectors and currencies is not just an academic observation. For active managers, it creates a source of alpha that does not exist in conventional fixed income. More importantly, the greenium is not static. Supply and demand dynamics in different sectors can push green bond pricing to extremes in either direction, creating windows where green bonds are available at a meaningful discount to conventional equivalents.

In the utilities sector, for example, periods of heavy supply have at times pushed green bond yields above those of comparable conventional bonds, creating a window to buy at a discount before pricing normalises. The reverse is equally true: when a sector's greenium becomes expensive, rotating into cheaper sectors preserves value without compromising the sustainability objective. This kind of rotation is only possible for investors who are actively monitoring pricing differentials across the full cross-section of the market. For passive strategies, the greenium is simply the cost or benefit

the index delivers. For active managers, it is a source of return that compounds over time alongside the credit and duration decisions that drive conventional fixed income performance.

What this means for investors

The research suggests that fears about giving up returns by investing in green bonds are largely overstated. In the US, green bonds have consistently offered higher yields or traded at lower prices than comparable conventional bonds. In Europe, green bond yields have generally been similar to conventional bonds, with any recent differences driven more by specific sectors and market conditions than by the green label itself. A more detailed summary of the study is provided in the appendix.

More importantly, any remaining yield differences can be managed relatively easily through sector and currency positioning. In some parts of the market, particularly in the US where negative sentiment towards ESG has pushed green bond yields higher, investors are actually being rewarded rather than penalised for choosing the sustainable option. If some investors have held back on investing in sustainable fixed income because of performance concerns, it may be time to reconsider. The next chapter examines how to capture sustainable fixed income value responsibly, and why the quality of the investment process matters as much as the investment opportunity.

Chapter 6

Capturing value responsibly in sustainable fixed income

Capturing value responsibly in sustainable fixed income

As the green bond market has grown, so has the range and complexity of what is being issued under the sustainable label. From an investment perspective, choosing between a green bond that genuinely delivers on its promises – and one that merely carries the label – comes down to the quality of the investment process behind it.

This chapter sets out what that process looks like in practice, and why active management, deep credit expertise and rigorous issuer engagement are essential to capturing value responsibly in this market.

Investment discipline and greenwashing risk

The growth of the sustainable bond market has brought with it a corresponding growth in greenwashing risk. As more issuers enter the market – and the range of frameworks, structures and labels multiplies – the gap between what is claimed and what is delivered can widen. For investors, the label on a bond should really be considered just the starting point for assessment, rather than the conclusion.

In many cases, the decision taken not to invest is as important as the decision to invest. Over the past year, our investment teams have passed on labelled bonds from several issuers that failed to meet the required standard. For example:

- A large food services business was excluded because its allocation and impact reporting lacked sufficient transparency, with no meaningful visibility on how proceeds were being deployed or what environmental outcomes were being achieved.
- A global life sciences company was excluded following concerns about alleged involvement in activities that raised serious questions around civil liberties and human rights, which were deemed incompatible with the fund's sustainable impact objectives.
- A major international retailer was excluded on the basis that its use-of-proceeds framework lacked ambition and credibility, with limited visibility on net environmental benefits and insufficient safeguards to mitigate negative environmental and social impacts within its supply chain.

That last example points to one of the more subtle greenwashing risks in the market today. As the scope of sustainable finance broadens, particularly with the introduction of transition bond guidelines covering sectors that are harder to decarbonise, the risk of financing a technically eligible project for an issuer with no genuine commitment to change becomes more serious. A company can issue a technically eligible green bond while its broader strategy has little to do with genuine environmental progress. Spotting this requires looking beyond the bond framework to how the issuer actually runs its business.

This does not mean avoiding all high-emitting sectors. Some of the most meaningful opportunities in sustainable fixed income involve companies that will continue to generate emissions for years but are making genuine, measurable progress toward reducing them. The question is whether an issuer is truly committed to change or simply financing an isolated project while business continues as usual. Making that judgment is what active management is for, and it is something no passive strategy can do.

Rigorous credit assessment

At Amova Asset Management, every portfolio holding is assessed through a proprietary bottom-up review process that examines three distinct lenses: the issuer's overall sustainability strategy, the pre-issuance bond framework, and the post-issuance allocation and impact report. Pre-issuance analysis focuses on the quality of the framework itself: whether the use of

proceeds is clearly defined, whether the eligible project categories are genuinely aligned with environmental or social objectives, and whether the governance around proceeds management is robust. Post-issuance analysis then tracks whether those commitments are being honoured in practice, through allocation reports, impact metrics and ongoing disclosure.

Use of proceeds is central to this assessment. Unlike conventional bonds, where capital raised can be deployed at the issuer's discretion, green and sustainable bonds are defined by the specific projects they finance. Verifying that proceeds are being allocated as promised, and there is evidence that the projects funded are contributing to environmental or social objectives, requires ongoing monitoring rather than a one-time check at the point of purchase.

Key performance indicators and impact metrics matter too. We map each holding to relevant UN Sustainable Development Goals and track quantitative impact data, including CO_2 reduction metrics, to assess the contribution of each investment based on available data. This level of granularity helps the team report more meaningfully on impact to investors, rather than relying on broad assertions about sustainability.

The role of data and technology

One of the most significant developments since the previous guide is the expansion of the data infrastructure available to support sustainable investment decisions. The team has access to enhanced ESG databases, improved SDG mapping tools and more granular impact metrics than were available when the first guide was written. These tools help the team to assess the sustainability credentials of issuers and bonds with greater precision, to identify gaps in disclosure more quickly and to report on impact more consistently.

Portfolio construction and diversification

As discussed in Chapter 3, sustainable fixed income portfolios offer meaningful diversification benefits relative to traditional global fixed income benchmarks, including duration characteristics that can act as a hedge during periods of geopolitical volatility, reduced concentration risk away from AI-heavy US investment grade debt, and currency diversification through the market's growing EUR orientation. These portfolio construction considerations are an integral part of how we approach the sustainable fixed income universe, not an afterthought to the sustainability objective.

Where portfolios include emerging market exposure, additional diligence is required. Many emerging market issuers are at an earlier stage of sustainability disclosure, and the governance frameworks around use of proceeds and impact reporting can be less developed than in more established markets. Transparency, governance standards and reporting quality therefore require particular scrutiny in this part of the universe, and engagement with issuers plays an even more important role in bridging disclosure gaps.

Pricing dynamics and relative value

As the research presented in Chapter 5 demonstrates, the assumption that green bonds are uniformly expensive relative to conventional equivalents does not hold up under scrutiny. Pricing dynamics vary meaningfully by currency and sector, and in some markets, particularly the US, ESG aversion has created conditions where green bonds offer higher yields than comparable conventional bonds. Understanding these dynamics is part of capturing value responsibly. It means investors do not have to choose between sustainability and performance, and in some cases can access both simultaneously through careful sector and currency positioning.

Regulatory standards and portfolio integrity

The EU's sustainable finance regulations classify investment funds according to the stringency of their sustainability commitments, with Article 9 representing the highest standard. Article 9 funds have explicit sustainable investment as their objective and must maintain a minimum allocation to qualifying investments.

When regulatory changes prompted many fund managers to reassess their classifications, a number of strategies were downgraded to accommodate a broader set of assets. We took a different decision: to make the portfolio adjustments necessary to maintain Article 9 status, with a 90% minimum allocation to climate-focused investments. That decision reflects a straightforward principle. Investors who choose a dedicated green bond strategy should be able to trust that the portfolio remains aligned with that objective,

While diversification can help reduce risk in a portfolio, it does not guarantee profits or protect against losses in a declining market.

not gradually diluted by a wider set of sustainability-linked or transition assets.

Engagement and active stewardship

There is a common misconception that fixed income investors have less influence over companies than equity investors, given bondholders do not carry voting rights. In practice, the relationship between a significant bondholder and an issuer carries its own form of influence. Companies that rely on the bond market for long-term financing have a direct interest in maintaining the confidence of their investors, and that creates leverage and opportunities for engagement.

Active stewardship in sustainable fixed income means using that leverage constructively: meeting regularly with management teams, raising questions about the credibility of sustainability strategies, and pushing for clearer and more consistent disclosure. Where an issuer's reporting falls short of what is needed to assess real-world impact based on available data, engagement is the mechanism through which those gaps can be closed. It is also the mechanism through which investors can signal what standards they expect, both from individual issuers and from the market more broadly.

Why active management matters

The sustainable fixed income market rewards careful judgment. The range of quality across issuers, frameworks and geographies is wide, and the consequences of misjudging an issuer's credentials extend beyond financial performance to the integrity of the portfolio itself. In our view, a passive strategy that tracks an index cannot make these judgements and will include bonds that may pass a screen but not withstand closer scrutiny. We would also caution that it lacks the full range of tools needed to engage with issuers and drive improvements in standards over time.

Active management adds value by recognising a credible transformation when the evidence supports it, identifying the gap between a bond framework and an issuer's actual conduct, and opting to pass on a labelled bond that on closer inspection lacks substance. These are not decisions that can be automated or delegated to an index, but are the product of experience, rigour and a genuine commitment to what sustainable fixed income is supposed to achieve.

Conclusion

A key asset class in the current environment

A key asset class in the current environment

When the first edition of this guide was published in 2023, the investment case for green bonds rested primarily on climate ambition. The need to limit global warming, fund the energy transition and meet net zero targets was urgent enough on its own terms. What has changed since then is not that this case has weakened, but that it has been joined by a set of structural drivers that make sustainable fixed income increasingly relevant and of growing interest to a broader range of investors in recent years.

The world has delivered a series of sharp lessons in the past few years about the cost of fragility. Energy systems proved more vulnerable than assumed. Supply chains that looked efficient in stable conditions proved brittle under stress. AI is restructuring the global economy while consuming energy at a once unimaginable scale, and geopolitical tensions that once felt distant are shaping investment returns directly. Each of these developments has strengthened the case for assets that provide resilience, genuine diversification and a direct link to the physical infrastructure our economies cannot function without.

Green bonds occupy this territory. They finance the electricity grids, renewable energy capacity, water systems, transport networks and industrial transition projects that modern societies depend on. They do so with a level of transparency, through use-of-proceeds reporting, impact metrics and ongoing disclosure, that often provides additional insight relative to conventional fixed income. And as the research presented in this guide demonstrates, the sustainability label may increasingly be linked to potential sources of value rather than viewed as a cost. Moreover, at a moment when passive global credit allocations are becoming increasingly concentrated in AI-related USD debt, the geographic and sectoral diversification of sustainable fixed income may be particularly relevant in the current environment.

But the expansion of the green bond market means that discernment is still a necessity. Distinguishing between a bond that seeks to deliver on its sustainability promises and one that merely carries the label requires deep fixed income expertise, rigorous pre and post-issuance analysis, and active engagement with issuers throughout the investment lifecycle. It requires, in short, the kind of investment discipline that has been at the heart of our approach to this market since 2010.

The energy transition, the build-out of digital infrastructure, and the shift toward more resilient and secure economic systems are not short-term trends. They will likely be the challenges that shape the global landscape for several decades, and the capital required to address them will flow primarily through debt markets. For fixed income investors, that is both a responsibility and an opportunity. We believe sustainable fixed income, approached with the rigour and discipline it deserves, is one of the most exciting and rewarding places to be in global investment markets today.

The Amova Asset Management Global Fixed Income Team

Appendix

The Greenium in Corporate Bond Spreads

Pooled OLS, Currency-Split Estimation, Model Selection & Sequential Robustness

RESEARCH NOTE · FIXED-INCOME / SUSTAINABLE DEBT
Dependent variable: OAS_w_log · N = 2,135,632 bond-observations

This note isolates the **greenium** — the spread differential between green bonds and otherwise-comparable conventional bonds — using a fully saturated fixed-effects panel of option-adjusted spreads. The central finding is that the greenium is **not a single number: it is sign-dependent on currency and conditional on market state**. EUR green bonds carry a robust, economically meaningful greenium of roughly 5 bps of spread; USD green bonds show no greenium and, if anything, a small positive differential best read as a composition effect. The pooled estimate (~2 bps) is a misleading average of two structurally different markets.

1. What the Exercise Does

The dependent variable is **OAS_w_log**, the natural log of the option-adjusted spread. Because the model is specified in logs, the green-bond dummy is interpreted as an approximate *proportional* effect on spread; the bysegment tables rescale this into **basis points** for direct economic reading. A **negative** coefficient means green bonds trade *tighter* — a genuine greenium, where investors accept lower yield for the green label. A **positive** coefficient means green bonds trade *wider*.

Identification rests on Pooled OLS with a saturated fixed-effects structure — **Rating, Industry, Currency and Year FE** — and **HC1 heteroskedasticity-robust standard errors**. The FE block does the heavy lifting: a green bond from a AAA utility is compared against a conventional AAA utility in the same year, not against the whole universe. The remaining regressors capture bond-level risk and structure: coupon, tenor, age, effective duration, effective convexity, issue size, and a set of stress / volatility / liquidity measures.

2. The Three Regression Tables — Greenium by Currency

The headline result is that pooling currencies conceals two opposite-signed markets. The table below reports the Green Bond Dummy coefficient across the four specifications (A–D) for each sample.

Sample	A: Composite	B: +Volatility	C: +Liq. Stress	D: Components	N (obs)	Reading
Pooled	−0.020	−0.022	−0.020	−0.022	2,135,632	Modest greenium
EUR	−0.053	−0.053	−0.053	−0.052	606,693	Strong greenium
USD	+0.047	+0.040	+0.045	+0.039	1,267,449	Sign flips — no greenium

For illustrative purposes only.

All coefficients significant at p<0.01. HC1 standard errors ≈ 0.002–0.003 throughout. Specifications A–D differ only in how stress is measured.

EUR shows a clear greenium of −0.052 to −0.053 — more than double the pooled estimate and stable to three decimals across every specification. This is consistent with a deep, mature, demand-driven market: a large dedicated green-investor base bids spreads tighter.

USD reverses sign to +0.039 to +0.047. This is the single most important result in the package and explains why the pooled number is small — it is a weighted blend of a strong negative EUR effect and a positive USD effect, with the larger USD sample (1.27m vs 0.61m obs) dragging the average toward zero. The positive USD sign is most plausibly a **composition** artefact — green issuance concentrated in different issuers, sectors and vintages — rather than a genuine "brownium".

The control coefficients behave sensibly throughout and lend credibility: higher coupon widens spread; longer tenor widens; older bonds tighten (seasoning); larger issues tighten in pooled/USD (liquidity premium); the stress flag and volatility/liquidity scores all enter strongly positive. Their stability across specifications signals a well-behaved model that is not fragile to which risk proxies are included.

3. Model Selection Criteria

Four nested specifications were compared on **Adjusted R^2, AIC and BIC**. Models A–C use composite/summary stress measures; Model D decomposes them into underlying components (TRR volatility, OAS 1-month change, price-vs-conventional gap).

Sample	Adj. R^2	AIC	BIC	Green coef	Green SE	Selected
A: Composite	0.7476	4,085,123	4,085,902	**−0.0199**	0.0018	
B: +Volatility	0.7522	4,046,224	4,047,016	**−0.0220**	0.0017	
C: +Liquidity Stress	0.7484	4,078,310	4,079,102	**−0.0204**	0.0018	
D: Components	**0.7540**	**4,030,310**	**4,031,128**	−0.0219	**0.0017**	✓ Best

For illustrative purposes only.

Model D wins on every criterion — highest Adjusted R^2 and lowest AIC and BIC. Critically, BIC — which penalises extra parameters heavily — still prefers D, so the gain is not an artefact of simply adding regressors: the decomposed risk factors carry genuine independent information. Equally reassuring, **the greenium coefficient is stable across all four models** (−0.0199 to −0.0220). Model selection is choosing the best-fitting specification, not rescuing a result that appears under only one setup — that stability is itself a robustness check.

4. Sequential Variable Addition — The Core Robustness Test

Controls are added one at a time and the greenium is tracked at each step. A *true* greenium should survive the introduction of risk and structure controls; a *spurious* one collapses. The table reports the Green coefficient at each step for the three samples.

Pooled — survives the full control set

Starts at −0.0168 (FE only) and, as each control enters, stays negative and actually strengthens, settling at −0.0253. It never changes sign and never loses significance. The greenium is not an artefact of the FE structure — it persists

Step	Pooled coef	EUR coef	USD coef
FE only	−0.0168	+0.0059	+0.0055
+ Coupon	+0.0112	+0.0125	+0.0492
+ Tenor	+0.0408	+0.0301	+0.0855
+ Age	−0.0141	−0.0441	+0.0472
+ Eff Duration	−0.0187	−0.0494	+0.0495
+ Eff Convexity	−0.0225	−0.0527	+0.0499
+ Liquidity	−0.0219	−0.0522	+0.0469
+ Volatility	−0.0248	−0.0517	+0.0379
+ Price Gap	−0.0247	−0.0517	+0.0379
+ Liq. Stress	−0.0246	−0.0509	+0.0373
+ Stress Flag	−0.0253	−0.0508	+0.0355

For illustrative purposes only.

EUR — the most convincing case

With FE only the EUR coefficient is *positive* (+0.0059) and remains mildly positive through coupon and tenor — then collapses sharply to −0.0441 the moment Age enters, drifting further to −0.0508 by the end. Interpretation: EUR green bonds are systematically *younger* than the conventional comparison set, and newer bonds carry wider spreads. Until age is controlled, this vintage effect *masks* the greenium. Once age is in, the true negative greenium emerges and is stable through every subsequent control — exactly the signature of a real effect uncovered by correct conditioning, not a fragile correlation.

USD — equally informative, opposite conclusion

Starts near zero and insignificant (+0.0055, p = 0.14). Adding coupon and tenor pushes it strongly positive (+0.085), and it stays positive (+0.035 to +0.050) through every remaining control. The positive USD differential is robust *in the sense of being stable*, but its origin is the coupon/tenor adjustment: USD green bonds differ in coupon and maturity structure such that, once controlled, they look *cheap*. This is best read as a composition / segmentation result — not evidence that USD investors penalise green bonds.

5. How Robust Is the Result?

The analysis is robust along several independent dimensions, which matters more than any single test:

- The greenium survives a saturated FE structure (rating × industry × currency × year) — it is not driven by issuer credit quality, sector or time.
- It is stable across four model specifications — the result does not depend on how stress is measured.
- It survives sequential addition of every risk and structural control; the EUR coefficient in particular converges to a stable negative value rather than wandering.
- The 2.1m-observation sample delivers very tight standard errors.

Interpretation caveat — significance vs. Magnitude

With N > 2 million, **everything is significant at the 1% level**; statistical significance is not the question. The honest read is on economic magnitude in basis points. The EUR greenium of roughly 5 bps of spread is economically meaningful; the pooled ~2 bps is marginal.

6. The Industry Cross-Section — Where the Greenium Actually Lives

Model D estimated by currency × industry shows the aggregate numbers conceal enormous heterogeneity. Selected segments (greenium in bps; negative = greenium):

EUR — strongest greenium	bps
Energy	−25.2
Insurance	−22.9
Technology & Electronics	−20.9
Utility (N_green = 12,437)	−14.9
Banking	−5.6
Financial Services	+14.0

USD — mixed picture	bps
Foreign Sovereign	−42.1
Automotive	−13.9
Banking	−4.6
Energy	+65.1
Transportation	+36.4
Insurance	+15.6

For illustrative purposes only.

In **EUR**, the greenium is genuine and concentrated in sectors with the deepest green-investor demand — Energy, Insurance, Technology and Utility. The Utility estimate (−14.9 bps on a large 12,437 green-bond sample) is the most reliable single number in the cross-section. Most EUR sectors show a negative greenium.

In **USD**, the picture is genuinely mixed: a real greenium in Foreign Sovereign (−42 bps) and Automotive (−14 bps), but positive differentials in Energy, Transportation, Healthcare and Insurance. The USD aggregate differential is not uniform — it is driven by specific sectors, reinforcing the composition interpretation.

Caveat — thin segments

Estimates from sectors with few green bonds — EUR Asset Backed (N_green = 74; +125.8 bps), USD Leisure (N_green = 22; +59.4 bps), USD Energy (N_green = 297 against ~100k obs) — have wide effective confidence intervals despite small reported SEs, and may be interpreted as noise rather than over-interpreted.

Bottom Line

1. EUR: evidence of a real greenium. A robust, economically meaningful greenium of roughly 5 bps of spread, concentrated in utilities, energy and technology. It survives a saturated FE structure, four model specifications and full sequential control addition — and *is revealed* by correct conditioning on bond age.

2. USD: no consistent greenium observed. If anything a small positive spread differential, best understood as a composition effect — different issuer, sector and maturity mix of green vs. conventional issuance — rather than investors demanding extra yield for green bonds.

3. The pooled number should be approached/interpreted with caution. The ~2 bps pooled estimate appear to be a misleading average of two oppositesigned markets. Currency segmentation appears to be the correct unit of analysis, and Model D (Components) appears to be the appropriate specification on AIC / BIC / Adjusted-R^2 grounds.

Methodology: Pooled OLS on OAS_w_log with Rating, Industry, Currency and Year fixed effects; HC1 robust standard errors. Four nested specifications (A–D) compared on Adjusted R^2, AIC and BIC. Sequential variable addition tracks the green-dummy coefficient as controls are introduced cumulatively. Interaction analysis augments Model D with one green_dummy × control term at a time. Cross-sectional estimates from Model D by currency × industry. Significance markers: *** p<0.01, ** p<0.05, * p<0.1. Given the sample size (N > 2.1m), economic magnitude in basis points should be prioritised over statistical significance.

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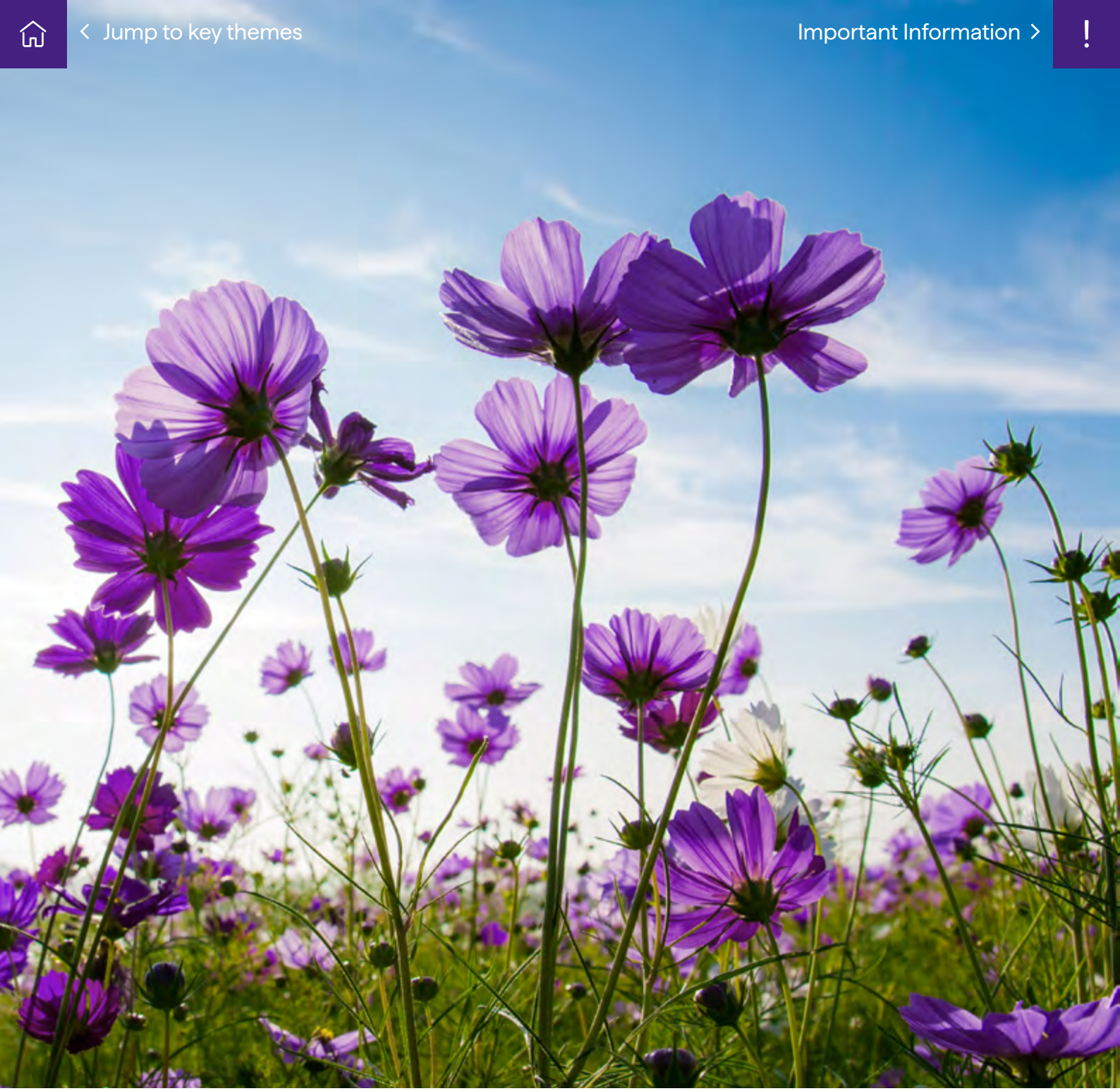

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