Institute and Faculty of Actuaries

Global net zero

How countries with the largest emissions are investing to finance the transition

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IFoA Net Zero and the Implications for Investment Portfolios Working Party

Pathways to Sustainability

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Key takeaways

Six of the highest-emitting countries produce 55% of global GHG emissions. These countries have a significant role to play in the transition and have active green finance markets.

Global climate finance (principally mitigation finance) hit an all-time high of USD$ 1.9 trillion in 2023 (Climate Policy Initiative, 2025). Green investment markets continue to grow, albeit at a slower rate than in previous years. Cuts to government budgets mean that private investments are now playing a bigger role in green market growth. Despite stepping back from climate-related initiatives, the USA remains a significant market, although the longer-term implications are unclear..

According to data from LSEG, the green bond market reached a record high of US$572 billion annual issuance in 2024 (LSEG, 2025), compared with the US$7.93 trillion of corporate bonds and leveraged loans issuance (Financial Times, 2024) or the total size of corporate and sovereign borrowing ($25 trillion issuance in 2024) (OECD, 2025). China has become the largest green bond issuance market in the world (International Monetary Fund, 2025), investing mostly in renewable energy projects and low carbon transport systems (Ma, J et al., 2019).

More innovative products, such as Sustainability Linked Bonds and Transition Bonds can also be used to fund projects that contribute towards the transition to net zero. These asset classes have been introduced relatively recently and are expected to address the shortcomings of the more traditional products (Dohle, 2024).

Green Infrastructure investing may offer greater diversification and increased returns. Institutional investors have historically favoured investments in existing infrastructure with lower risk profiles. However, significant investment in new infrastructure will be needed in order to bridge the climate financing gap.

Green and Environmental, Social, and Governance (ESG) funds are popular choices for institutional and private investors in both developed and developing markets, owing to their perceived lower risk levels and greater liquidity than direct investments.

The role of actuaries

Global green investment markets present opportunities

Apply overseas innovation to domestic investment markets.

Help pension schemes and insurers to support a net zero transition and climate adaption through a globally-diversified investment portfolio. Company and sector transition plans can help actuaries to identify these opportunities.

Asset owners can influence green investment markets

Engage with policymakers to shape a supportive policy environment for green investment.

Engage with companies they invest with on how they support the transition and climate adaptation.

Build trust in green markets

Challenge and validate sustainability reporting on green investments, including transition plans, and the companies that issue them.

Help to develop frameworks for measuring the financial impact of climate-related risks.

Introduction

The Net Zero and Implications for Investment Portfolios working party aims to help actuaries improve their understanding of what net zero means for an investment portfolio and what the key mechanisms are to achieve this, as well as key challenges to date and the outlook for development.

What we mean by 'green finance'

There is no single definition for green or sustainable finance but in this paper we consider green finance, as referred to by the United Nations Environment Programme Finance Initiative.

Sustainable finance products (United Nations Environment Programme Finance Initiative, 2016) consider environmental, social, economic and governance issues as well as financial returns.

Within sustainable finance, **green finance** is concerned with addressing environmental issues and risks.

This definition is not limited to labelled investments, which do not exist in many countries and the criteria vary significantly where they do.

Transition versus adaptation finance

The case studies in this paper are primarily examples of **transition finance**, which is finance used to support the transition of the global real economy to net zero (United Nations Environment Programme Finance Initiative, 2022)**. E**ven with drastic action to reduce greenhouse gas emissions, many risks from climate change will remain. This means that **adaptation finance**, funding directed at building resilience to climate change impacts, will become increasingly important. (United Nations Environment Programme Finance Initiative, 2025). Both types of finance are underfunded.

Sustainable and green finance products have existed for several decades (United Nations Environment Programme Finance Initiative, 2017), but markets for such products have grown significantly since the Paris Agreement (United Nations Framework Convention on Climate Change, 2016) was signed in 2015. This is because signatory countries need to raise significant levels of finance (Climate Policy Initiative, 2023) to support progress against their net zero commitments.

What does this paper focus on?

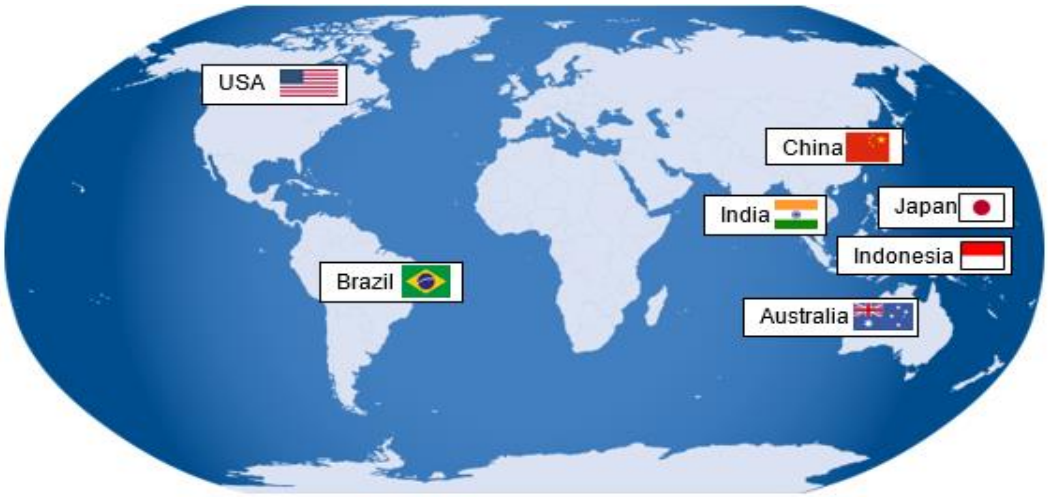
This paper provides an introduction to green investment markets around the world that aim to support efforts to reach global net zero, including:

- Key types of green investments and case studies
- The main participants within green investment markets
- The main factors that influence green investment markets, including the political environment, regulations and public sentiment

While carrying out the research for this paper, we note that it was very difficult to find one single source of key statistics about green investments in the public domain. This may be an area for the industry to explore further in future. In the absence of a single source, we have taken data from a wide range of public research papers and databases. The paper is not a complete picture, but aims to present key features of the green investment markets.

We focus on countries with the largest emissions in this paper, which have a significant role to play in the transition and have active green finance markets. Much attention has been given to the UK and EU green investment markets in recent years as they have adopted more rigorous standards for green investments (Financial Conduct Authority, 2023) (EUR-lex, 2019). However, the UK and EU make up only one part of the world economy and the investments. We therefore focus on the countries outside of the UK and EU, covering a sample of countries across different world regions. See Figure 1 for an overview of this sample of countries.

Figure 1: Countries considered in this paper, their net zero target years (Climate Action Tracker, 2025) **and the size of their emissions in 2024** (EDGAR, 2025)**, with comparison to EU27** (European Union, 2025) **and UK**



Country	Net zero target year	GHG emissions (Mt CO_2e)	GHG emissions as % of global total	Rank by GHG emissions	GHG per capita (t CO_2eq/cap)	GHG per GDP (tCO2eq/1k $)
Global		53,206	100.0		6.6	308
China	2060	15,536	29.2	1	10.8	462
USA	No Target	5,913	11.1	2	17.3	230
India	2070	4,371	8.2	3	3.0	307
Indonesia	2060	1,324	2.5	6	4.7	323
Brazil	2050	1,299	2.4	7	5.9	312
Japan	2050	1,063	2.0	8	8.5	186
Australia	2050	591	1.1	17	22.3	363
EU27	2050	3,165	6.0	4	7.1	129
UK	2050	387	0.7	23	5.6	106

Note: *The above country rankings by GHG emissions includes International Aviation and International Shipping.*

We note that there are some countries with large greenhouse gas (GHG) emissions that do not have significant green investment markets, generally due to them deciding not to pursue net zero goals as rapidly (for example, Saudi Arabia). There are also large developing countries, particularly in Africa, where emissions are comparatively low and they have less active green investment markets, but are highly impacted by climate change and so will need to accelerate green finance in the future (Climate Policy Initiative, 2025) (PWC, 2022). These countries are outside the scope of this paper.

The working party has also written a number of blogs looking at the green investment markets of individual countries, where you can read more (IFoA's Net Zero and the Implications for Investment Portfolios Working Party, 2025).

Summary: Why green investment markets are important to actuaries

Green investment markets represent a growing part of wider investment markets but are still poorly understood. In order to manage climate-related investment risks for their companies and clients, actuaries need to understand the available investment options better and broaden that understanding beyond UK and EU markets.

However, actuaries have a role to play beyond simply educating themselves on the subject. As part of our research, we found three key areas where we think actuaries have a role to play:

Countries around the world are innovating in a range of asset classes that support the transition to net zero.

Investment actuaries can learn from innovation overseas and apply that in domestic markets.

These growing international markets also present a range of investment opportunities that help pension schemes and insurers to support a net zero transition and climate adaptation through their investments as part of a globally-diversified portfolio. Company and sector transition plans can help actuaries to identify these opportunities.

Global green investment markets present opportunities

Green investment markets are not just shaped by supply and demand, they are also influenced by politics, regulation and stakeholder actions.

Pension schemes and insurance companies are large asset owners. This gives them influence to engage with companies they invest with on how they support the transition and climate adaptation.

Asset owners can engage with policymakers to shape a policy environment that supports green investment.

Asset owners can influence green investment markets

Actuaries can challenge and validate sustainability reporting on green investments, including transition plans, and the companies that issue them.

They can help to develop frameworks for measuring the financial impact of climate-related risks.

Robust and transparent reporting and risk management builds trust in investment markets.

Actuaries can also advise their clients on what 'good' green investing looks like and how to incorporate this into their asset portfolios.

Actuaries can help build trust in green markets

Note: Transition plans are a detailed roadmap for achieving net-zero goals (International Transition Plan Network, 2025)

Types of green investment

This section explores some of the main asset classes existing in the green investment sector, with a focus on their defining features, as well as their presence in various markets.

In recent years, net zero commitments have led to large investments mostly in energy systems, transport electrification and energy-efficient buildings. Between 2018 and 2023, just over 60% of this climate finance has been through debt instruments (Climate Policy Initiative, 2025), although this is skewed by public sector investments - the split between debt and equity was almost even for the private sector in 2023.

The range of investment classes available in each market varies considerably, due to differences in each country's economic development, regulatory framework and political and social pressures - see the later sections in this paper on influences on green investment markets. In countries such as China, government plays a dominant role, leading to a focus on green bonds and credit (Qian, S. and Yu, W., 2024) and equity instruments issued by state-owned enterprises to expand grid infrastructure (Climate Policy Initiative, 2025). In other countries there is more focus on private sector initiatives or innovation of new product types.

One of the earliest and most widely-used forms of green finance available was green bonds, whose proceeds are used to finance projects which benefit the environment. Since the Paris Agreement in 2015, the market for green bonds has continued to grow rapidly (Climate Aligned, 2025). While the market for green bonds is relatively mature and accounts for the majority of green investments, these products do not necessarily have the most impact on reducing carbon emissions. One reason is that there is no global mandatory standard for the projects green bonds can be used to finance.

More innovative products, such as Sustainability Linked Bonds and Transition Bonds can also be used to fund projects that contribute towards the transition to net zero. These asset classes have been introduced relatively recently and are expected to address the shortcomings of the more traditional products (Dohle, 2024). Unlike green bonds, they focus on the targets of the investment rather than how the funds are used. The financial characteristics of Sustainability Linked Bonds in particular are determined based on predefined sustainability objectives and therefore provide higher levels of transparency and accountability. This is expected to significantly reduce any risk of greenwashing. However, these products remain in the early stages of development and their market shares are still relatively insignificant.

Green investment markets have seen sustained growth while there has been political consensus on net zero. More recently, there has been a rise of anti-ESG sentiment in the US. That has led to some 'anti-ESG' products being marketed. This, together with the economic impacts of US tariffs and the US stepping back from climate-related initiatives and treaties, is also likely to lead to changes in supply and demand of green investment products in the US. In the shorter-term, there has been continued large issuances from US companies (Deshmukh, A., 2025), but potentially lower investor interest (Pendered, D., 2025). However, the longer-term effects remain unclear.

Actuaries can learn from innovation happening overseas to develop domestic investment markets. They can also help pension schemes and insurers to support a net zero transition and climate adaptation through a globally-diversified investment portfolio. Company and sector transition plans can help actuaries to identify potential investment opportunities.

We could not find a consistent public data source. Asset class definitions or whether data is quoted at half-year or year-end may vary between sources. Data is not always available for all countries.

Green bonds

In existence for nearly 20 years (Climate Aligned, 2025), the market for green bonds is a relatively mature market with hundreds of billions of annual issuance (USD $572bn issued worldwide in 2024) (LSEG, 2025). This does, however, remain small compared with the US$7.93 trillion of corporate bonds and leveraged loans issuance (Financial Times, 2024) or the total size of corporate and sovereign borrowing ($25 trillion issuance in 2024) (OECD, 2025).

Green bonds are labelled bonds whose proceeds are used to finance projects which benefit the environment.

Green bonds are sometimes used to refer to the more general category of **Green, Social, Sustainable and Other Labelled (GSS+) bonds** which also cover social, sustainable, transition and sustainability-linked bonds (see later in this section for more on some of these).

The European Investment Bank first issued a €600 million "Climate Awareness Bond" in 2007, followed by the World Bank issuing the first green bond in 2008 (Climate Aligned, 2025). Initially issued mostly by multilateral development banks, they are now issued by countries around the world.

Although Europe continues to be the largest issuer of green bond by continent, Asia is a fast-growing market. In 2023 China became the country with the largest annual issuance of green bonds (nearly USD $65bn in 2024, excluding Hong Kong and Macau) (International Monetary Fund, 2025).

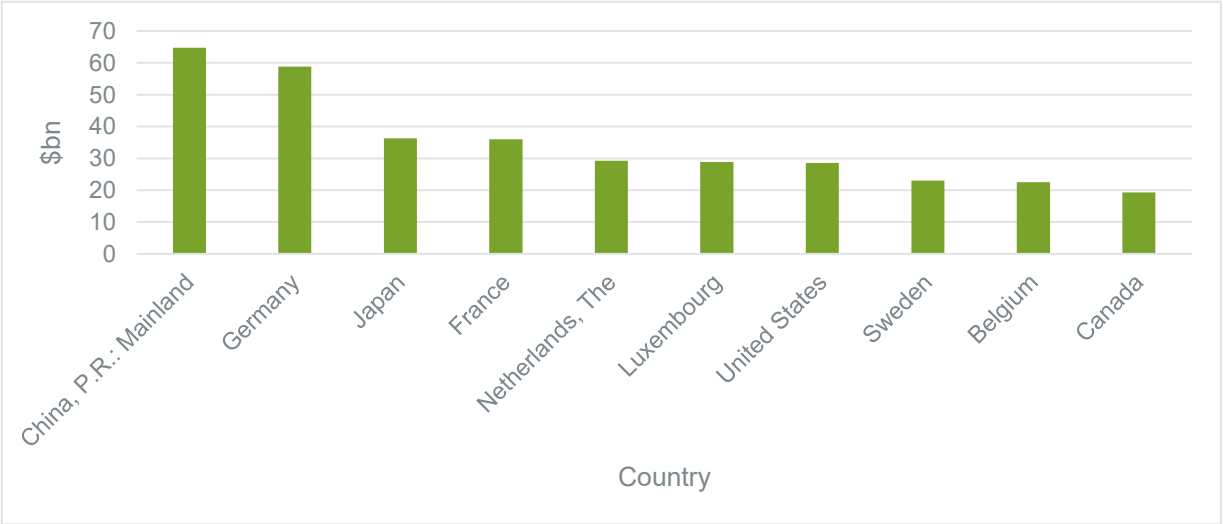
While there is no global mandatory standard for the projects green bonds can be used to finance, the International Capital Markets Association (ICMA) has issued a voluntary Green Bonds Principles (ICMA, 2021). Countries such as China have published local frameworks for the green bonds they issue.

Spotlight on China

China's first green bond (Ma, J et al., 2019) was issued in 2015 by the People's Bank of China and China has since become the largest green bond issuance market in the world. The vast majority of proceeds from green bonds are used to fund renewable energy projects such as solar and wind power generating capacity, and low carbon transport such as electric vehicles and transit systems.

China was the first country in the world (Yu, 2016) to publish guidelines on green bonds in 2015. In 2022, China's Green Bond Standard Committee issued a set of voluntary Green Bond Principles (ICMA, 2022) aimed at aligning China's green bond issuances to international standards, including using 100% of the proceeds of green bonds to fund green projects.

Figure 2. Top 10 issuers of green bonds by country in 2024 (International Monetary Fund, 2025)



Infrastructure investment

Green Infrastructure investing is seen as an attractive alternative asset class for investors seeking greater diversification and increased returns. Direct investment allows for greater control over project outcomes and closer alignment with ESG targets where similar investing opportunities are not available (Choi, E. and Zhou, L., 2023). However, because of the size of investment required access to such investments is usually limited to the largest institutional investors. It can be possible for smaller investors to access infrastructure investments via the secondary markets by investing in infrastructure private equity funds.

Green infrastructure investment - direct investments into infrastructure projects which help to reduce greenhouse gas emissions compared to traditional infrastructure. These include projects for renewable energy generation, low carbon transport systems and reducing carbon emissions of existing infrastructure.

While some of the more liquid forms of green investing, such as green bonds, provide financing for green infrastructure projects as well, these secondary market investments are more prevalent in developed economies with mature financial markets.

Institutional investors have historically favoured investments in existing infrastructure with lower risk profiles. However, the UN estimates that 75% of infrastructure required by 2050 is yet to be built and mainly in emerging markets. Therefore, significant investment in new infrastructure will be needed in order to bridge this gap.

In addition, without clear definitions of sustainable or green projects, particularly in emerging economies, investors are susceptible to greenwashing. The FAST-Infra (Finance to Accelerate the Sustainable Transition-Infrastructure) initiative launched the Sustainable Infrastructure label at COP 26 in November 2021 (Climate Policy Initiative, 2021) to evaluate sustainable infrastructure assets. This label aims to help to bridge the gap in infrastructure investing where there is lack of expertise to identify and monitor sustainable infrastructure investment opportunities (Environmental Finance, 2024).

Spotlight on India

The Indian Government has set a goal of 500GW of renewable energy by 2030. Some investments to achieve this target include:

- The Bhadla solar park, which is one of the world's largest solar farms, was built using financing from the Climate Investment Fund (CIF) and other multilateral development banks. (Fenice Energy, 2024)

- Alterra, the world's largest private climate investment fund and Brookfield Asset Management, injected USD$100m into **Evren** for a range of clean energy projects. (Alterra, 2025)

Green and ESG Investment Funds

Within the regions we have focussed on in this paper, green and ESG investments funds generally feature as a significant part of their green investment landscape. These enable institutional and retail investors to access green investments via the secondary markets where they may not otherwise have sufficient scale or risk appetite to invest directly.

Green investment funds - investment funds which aim to achieve positive environmental outcomes. For example, the proceeds are used to finance 'green' projects, invest in environment friendly companies or purchase other green investment products. Green funds may hold investments in companies within higher emission sectors where those companies have significant investments in green projects or as a means to influence the pace at which they transition to more sustainable energy sources. These funds generally invest in secondary market equity and corporate bonds.

Green investment funds usually have a main investment theme relating to environment friendly objectives such as green energy or transport. They may use portfolio alignment metrics to target a certain temperature alignment score or level of emissions in the portfolio - for examples of these see our previous paper on portfolio alignment metrics (Bryson, R., et al, 2024)

Spotlight on thematic investing in the USA

One example of a thematic fund offered by an asset manager in the USA is the AB Sustainable International Thematic Fund (Alliance Bernstein, 2025). This is a benchmark-agnostic non-U.S. equity portfolio built around forward-looking thematic opportunities. It employs a "top-down" and "bottom-up" investment process with the goal of identifying securities that fit into sustainable investment themes that are broadly consistent with achieving the UN Sustainable Development Goals.

Spotlight on thematic investing in Brazil

The Vinci Climate Change Fund is an infrastructure equity fund (so also an example of a secondary infrastructure investment). It invests in projects in Brazil in the renewable energy, water and sewerage sectors, and in solutions for carbon emission reduction, energy storage and energy efficiency.

With a target size of 400 million US dollars, it has received significant European investment, including a 2023 commitment of 52.5 million US dollars from the European Investment Bank.

ESG investment funds - investment funds which invest in companies that meet specific environmental, social, and governance (ESG) criteria. However, unlike green investment funds, they are not necessarily seeking a positive environmental outcome.

One common type of ESG investment fund is a 'tilted' fund. This increases the target weight in companies with better climate-related characteristics (e.g. lower greenhouse gas emissions) and decreases the target weight in companies with worse climate-related characteristics.

Spotlight on ESG investment funds around the world

ESG funds have significant volumes in markets around the world, despite geopolitical and regulatory uncertainties (Morningstar, 2023).

USA

Despite a rise in 'anti-ESG' sentiment in the USA and net outflows seen over the last year, the value of money invested in ESG funds continues to rise, with USD$597 billion of mutual funds and Exchange Traded Funds (ETF) assets invested as of July 2025 (Investment Company Institute, 2025).

China

There is continuing expansion of ESG Investments in China, with over 296 mutual funds as of 2024 now focusing on sustainability, with assets surpassing USD$55.5 billion. This has been driven by ESG and thematic ETFs aligned with national carbon-neutral goals, thereby attracting policy support and marketing prominence (Mordor Intelligence, 2025).

India

India's ESG funds market is much smaller, with 9 active funds managing about USD$1.3 billion (Center for Sustainable Finance India, 2024). There was an initial rush towards these funds around 2020, but more recently interest has been declining with continuous outflows (Financial Express, 2024).

Brazil

As of June 2023, there were 53 ESG mutual funds - equities and bonds - in the Brazilian Association of Financial and Capital Markets Entities fund universe (Exame, 2023). Many of these, such as the longest-running Santander Ethical Ações Sustentabilidad Fund launched in November 2001, follow a broader ESG theme. Others, however, like the BNP Access Energy Transition Sustainability IS, are more narrowly focused on aspects such as the energy transition.

Indonesia

Indonesia has a comparatively small mutual fund industry, but still offers ESG funds that share many characteristics with those from more mature markets. One example is the Mandiri Indeks FTSE Indonesia ESG Fund (Mandiri Investasi, 2025), launched in May 2022. This fund aims to provide investment returns equivalent to the performance of the FTSE Indonesia ESG Index.

Australia and New Zealand

As of June 2025, there were 288 sustainable open-end and exchange-traded funds in Australia and New Zealand with assets of USD$34 billion (Morningstar, 2025).

Green Credit (Loans)

Green Credit (Loans) - the characteristics of green loans look very similar to traditional loan instruments. However, the main difference with green loans is the borrower must use the proceeds of the loan exclusively for 'green' projects. In comparison to green bonds, green loans usually involve smaller loan amounts and are private transactions only i.e. cannot be traded on an exchange.

The green investment market in China is dominated by green loans (Yue, M. and Nedopil, C., 2025).

Outside of China, green loans represent one of the smallest segments of green finance and do not feature as a major source of green finance in any of the other markets featured in this paper.

As green loans are private transactions, the first issuance of green loans is unknown.

In 2012 the China Banking Regulatory Commission (CBRC) issued the Green Credit Guidelines (GCG) as one of the earliest pioneers in this form of green finance (Huang, Z. et al., 2023). The 2018 Green Loan Principles (Loan Market Association, 2018) were the first set of international published market consistent standards. The Green Credit Guidelines are unique because these are issued by the Chinese Government and enforced by the CBRC whereas adherence to the Green Loan Principles is voluntary.

Spotlight on China

Green credit was the earliest form of green investment available in China and accounts for the majority of its available green financing. As at the end of 2024, the total outstanding green loan balance reached USD$4.9 trillion and represents 13.9% of total outstanding loan balance (Yue, M. and Nedopil, C., 2025).

Proceeds from green loans have predominantly been used for infrastructure upgrades and clean energy projects. This segment continues to grow relative to other forms of finance in China such as green bonds which have actually seen declines in issuances in recent years.

Green deposits

Green deposits are similar to fixed term deposits where funds are held for a specified term during which interest is accrued on the capital invested. However, the main difference from traditional fixed deposits is that the funds are used exclusively for 'green' projects. Financial institutions usually offer higher interest rates for green deposits relative to more traditional products as an added incentive to raise financing for 'green' projects.

Although a relatively small asset class in most major economies, green deposits are expected to be a key instrument in India's journey to net zero, with the Reserve Bank of India announcing a framework for green deposits in 2023 (Reserve Bank of India, 2023).

Sustainability Linked Bonds (SLBs)

SLBs represent one of the smallest segments of climate-themed issuances. Although the market is relatively young, there is a growing number of issuers in different currencies and countries each year.

Sustainability Linked Bonds (SLBs) are bonds for which the financial and/or structural characteristics can vary depending on whether the issuer achieved predefined sustainability/ESG objectives. The objectives are defined by a set of key performance indicators (KPIs) which are assessed against sustainability performance targets (SPTs) to be achieved within a pre-defined timeline. Some features of SLBs which can be linked to performance include coupon rates, redemption amounts and maturity dates. For example, if SPTs are not met, coupon rates and/or redemption amounts may increase or bonds can be redeemed early at a pre-determined redemption price. (ICMA, 2024)

Unlike green bonds, SLBs provide more flexibility to issuers in that the proceeds of the bonds are not ring-fenced to specific projects and can be allocated for general corporate purposes as part of the issuer's overall sustainability goals. These instruments are particularly suited to issuers who do not currently have significant expenditure in green projects but are looking to access funding to assist with transition.

The Sustainability-Linked Bond principles were the first set of guidelines published by ICMA in June 2020 (Norton Rose Fulbright, 2020).

Global cumulative issuances were USD$279 billion as at end 2023 (Climate Bonds Initiative, 2024) and were mainly concentrated in developed markets (Organisation for Economic Co-operation and Development, 2024). However, issuances in developing countries have been gaining traction, with the Latin American region the only region to show growth in 2023. China, where the first SLB originated in 2018, issued by Beijing Infrastructure Investment Co., tops the list by number of issuers and bonds and stands 4th on the list based on amount of issuances (USD$21.7 billion).

Spotlight on Brazil

SLBs are the second largest segment in the Brazil green debt market, representing 36% of the total market.

Brazil is also the largest source of SLBs in the Latin American and Caribbean (LAC) region, issuing 41% of SLBs in the LAC market with cumulative volumes of USD $12 billion in 2023 (Climate Bonds Initiative, 2023).

Transition Bonds

Issuances of Transition bonds are one of the smallest categories of GSS+ issuances globally and the market has seen limited growth outside of Japan in recent years.

Transition bonds are another type of GSS+ labelled bonds whose proceeds can be used for projects which help the transition to net zero by reducing carbon emissions.

Spotlight on Japan

Japan first issued transition bonds in 2021. The Japanese government issued the world's first sovereign climate transition bonds in 2024 (Climate Bonds Initiative, 2024). This initiative is a key part of Japan's Green Transformation (GX) programme (Environmental Finance, 2025). This sets out how Japan intends to finance its transition towards net zero in 2050. Transition bonds make up about 13% of the transition finance Japan aims to mobilise $1tn over the next decade.

The Japanese government is now the largest issuer of transition bonds in Japan while other major issuers include companies with relatively large greenhouse gas emission levels, including electric power, gas, and oil refining. industries

Because the funds can be used for projects which help transition to net zero by reducing carbon emissions, they are often issued by companies operating in high emission sectors such as oil and gas or steel. This means that this has been a controversial asset class - on the one hand critics argue that these bonds are an example of greenwashing, while supporters believe that such bonds are essential for these industries to transition to net zero.

The first transition bond was a $500 million bond issued in July 2017 by Hong Kong power company Castle Peak (Environmental Finance, 2024). After an initial surge of interest between 2019 and 2021, the market stagnated at under 1% of total annual sustainable bonds issued. Since 2021 the market has been dominated by Japan (at 68% of global issuance in 2024), with a limited number of other issuers (Nomura, 2024). The lack of transparency and standardised guidelines are likely factors affecting growth in this asset class.

Green sukuk

Green Sukuk have been developed to address the growing demand in the Middle and Far East for Shari'ah-compliant or Islamic bonds.

Green sukuk are Shari'ah compliant investments in renewable energy and other environmental assets.

This is a nascent, but fast-growing, asset class, that started to be developed in 2015 by the Green Sukuk Working Party (Climate Bonds Initiative, 2025). There are many opportunities for Green Sukuk in the solar energy plans of Gulf countries. A key issuer of green sukuk is Indonesia (Climate Bonds Initiative, 2022), for which this asset class is an important part of its commitment to sustainable financing and reducing greenhouse gas emissions (Republic of Indonesia, 2021).

Anti-ESG funds

While Anti-ESG funds have been around for more than two decades, due to low investment volumes they have historically remained obscure in the investment landscape. They have gained more prominence as politics becomes more polarised in the USA.

Anti-ESG funds - investment funds which exclude investments in businesses which meet certain ESG criteria. The ESG criteria used to determine whether an investment is suitable for the fund will vary depending on the overarching theme of the fund. These funds generally invest in secondary market equity and corporate bonds.

The origins of anti-ESG funds can be traced back to 2004 when the Free Enterprise Action Fund was created. This fund actively sought out investments in businesses which were targeted by social and environmental activists and excluded from ethically labelled funds.

Morningstar groups anti-ESG funds into the following broad categories. Note there may be some overlap across categories based on the specific criteria defined in the fund prospectus (Morningstar, 2023):

Spotlight on the USA

In 2022, 'Anti-ESG' funds grew substantially in the US, largely driven by the energy crisis and when Republican US Presidential candidate Vivek Ramaswamy launched the Strive US energy exchange traded funds (ETF) (ETF, 2025).

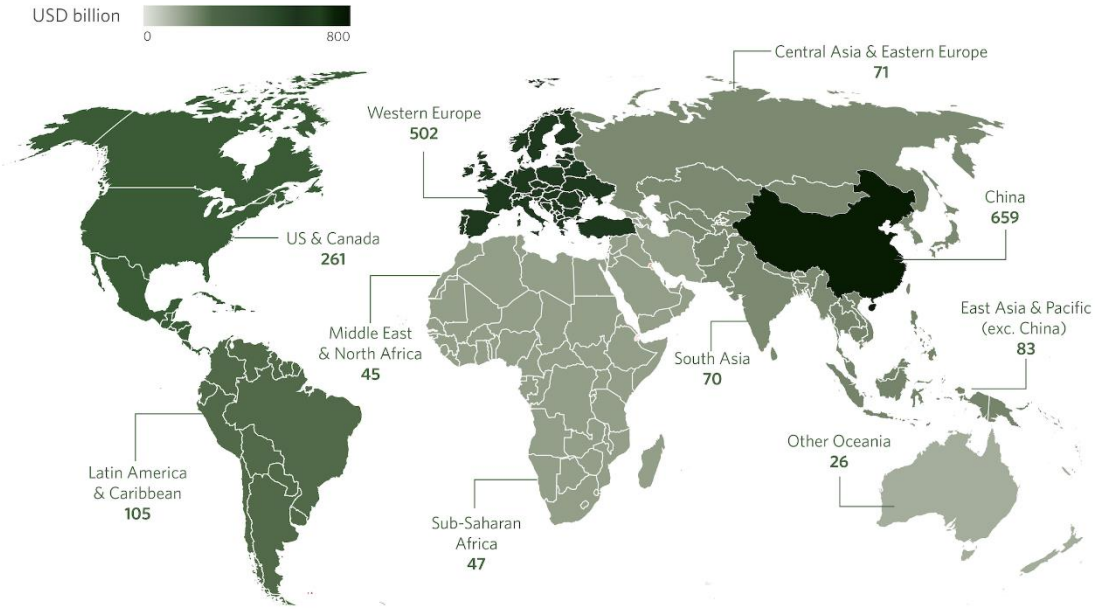
However, the size of these funds (USD $2.1 billion cumulative issuance as at March 2023) (Hood, D. and Park, Y., 2023) has remained relatively small in comparison to ESG funds and have seen net outflows in recent years.

Anti-ESG	Political	Voting	Renouncer	Vice
Funds which exclude companies which meet certain ESG criteria or include companies that are generally excluded from ESG funds.	Funds which invest in companies deemed to be in support of a conservative political agenda also referred to be “anti-woke” or against liberal ESG agendas.	Funds with voting policies which oppose ESG proposals at shareholder meetings.	Funds which have previously adhered to ESG investing principles but have subsequently removed all references to ESG investing principles to avoid being associated with an ESG agenda.	Funds which invest in companies generally excluded from social or ethical funds. These include the traditional 'sin stocks' covering tobacco, alcohol, weapons and gambling.

Main participants in green investment markets

Global climate finance hit an all-time high of USD$ 1.9 trillion in 2023 (Climate Policy Initiative, 2025). Of this USD$ 1.9 trillion, nearly USD$ 1.8 trillion was mitigation finance, with the rest adaptation finance or finance pursuing both adaptation and mitigation objectives. Early data suggests that climate finance may have exceeded USD$ 2 trillion in 2024. This shows that green investment markets continue to grow, but more slowly than recent years. This growth is mainly driven by a growth in private investments - public climate finance has fallen recently (by around 13% between 2022 and 2023) as there have been cuts to government budgets.

Figure 3: Total climate finance flows by region, 2023 (Climate Policy Initiative, 2025)



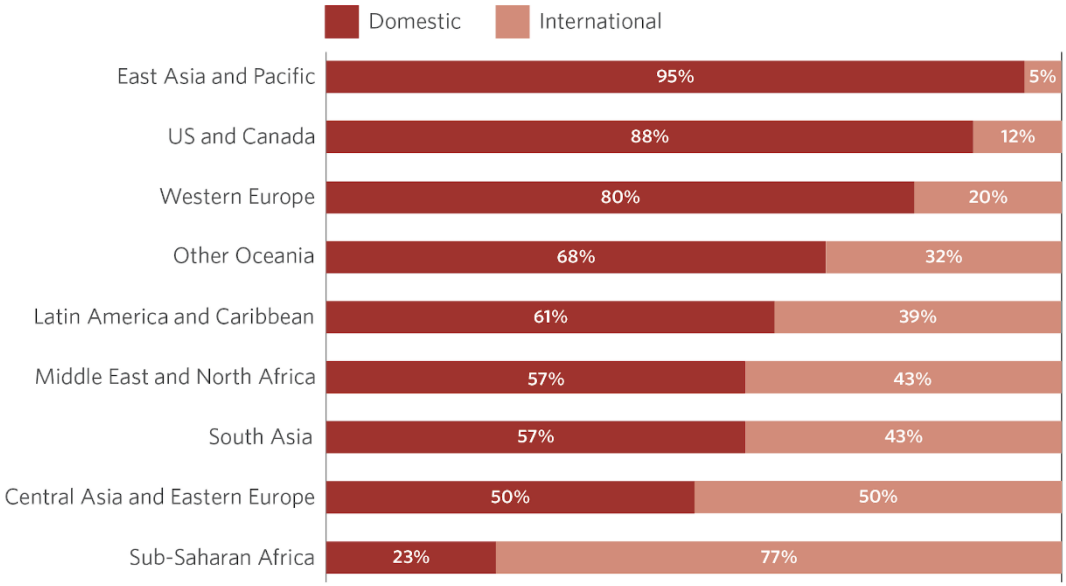
Note: Transregional and unknown flows totaled USD 35bn in 2023

East Asia and the Pacific, Western Europe, and the US and Canada are the three largest regions for green finance and there is an increasingly wide gap between regions with the highest and lowest flows. China dominated financing in East Asia and the Pacific (and indeed worldwide)—the Climate Policy Initiative notes “for every dollar mobilized in China, just 13 cents were mobilized in the rest of East Asia and the Pacific” - and clean-energy technologies made up more than 10% of China’s economy for the first time in 2024. The US, Brazil, and India are the leading countries for mobilising climate finance in their respective regions. The US has recently stepped back from climate initiatives and treaties. In the short term, their green investment markets remain significant; it is unclear what the longer-term implications of the shift in US politics will be.

Domestic versus international finance

Around 80% of climate finance was raised domestically rather than from international investors. However, this differs significantly between high-income and low-income countries. Lower income countries, who may also have greater need for climate finance due to there being a higher impact of climate change on their countries, tend to have a greater proportion of finance from international investors. See Figure 4.

Figure 4: Total climate finance domestic-international split by region, 2023 (Climate Policy Initiative, 2025)

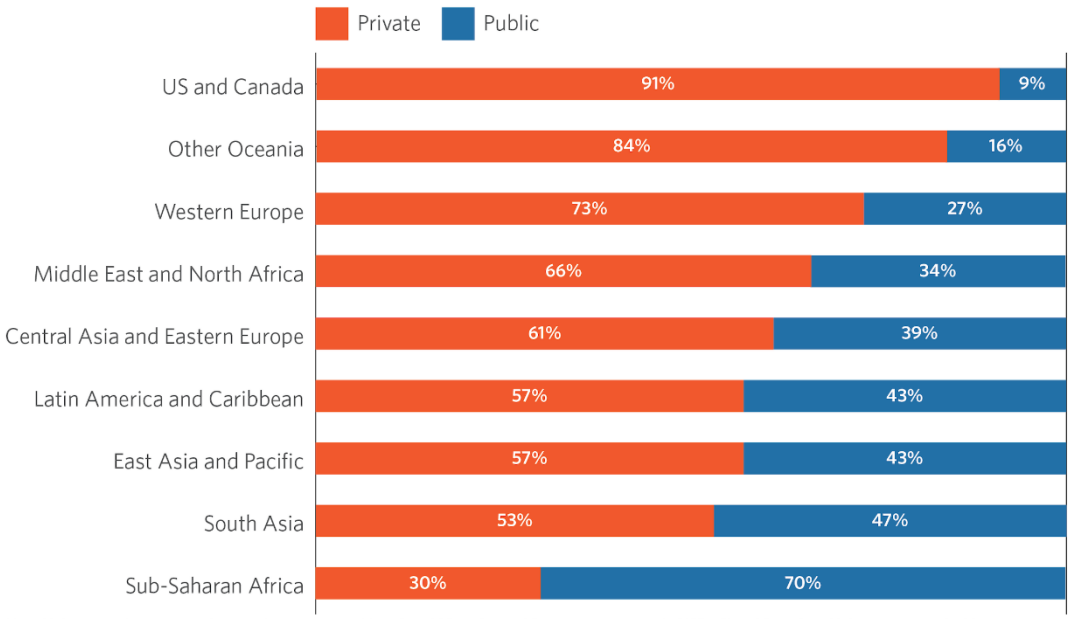


Note: Transregional flows are also present, with a domestic-international split of 15%-85% in 2023.

Public versus private finance

In 2023, private finance exceeded public, accounting for two-thirds of total global mitigation investment (Climate Policy Initiative, 2025). Transport finance in particular was over 70% provided by private actors due to the consumer market for electric vehicles. Public finance is used more in sectors with lower commercial returns or that are at early-stage development. The split between public and private finance varies significantly between regions. Higher-income regions have more private finance than lower-income, but it is also linked to the structure of economies in different regions. For example, the US, known for its free market approach, has mostly private finance. On the other hand, in countries such as China, government and public actors play a more dominant role.

Figure 5: Total climate finance public-private split by region, 2023 (Climate Policy Initiative, 2025)

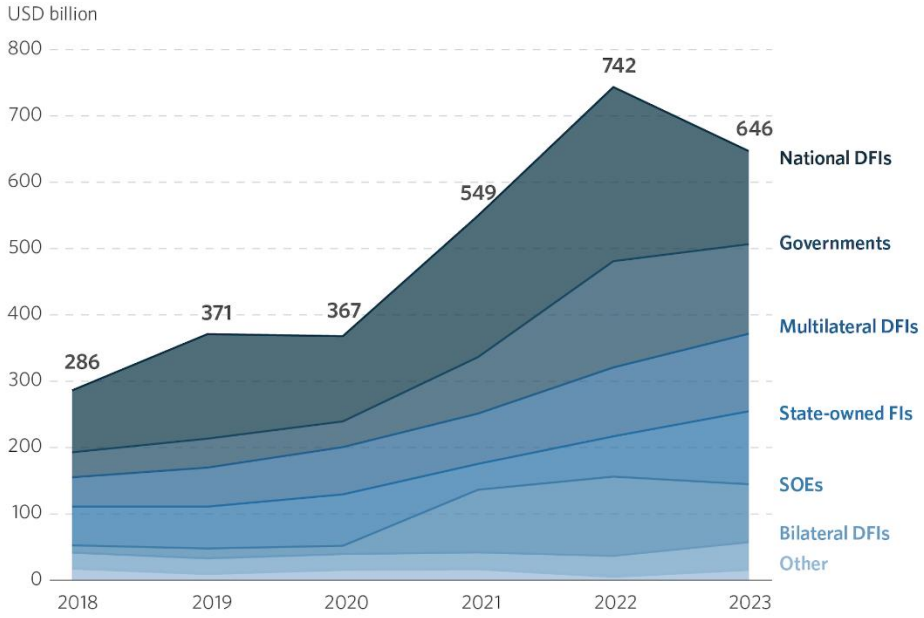


Note: Unknown and transregional regions have private-public splits of 90%-10% and 25%-75%, respectively. USD 1.2bn of flows from Unknown sources (public or private) are excluded from the figure.

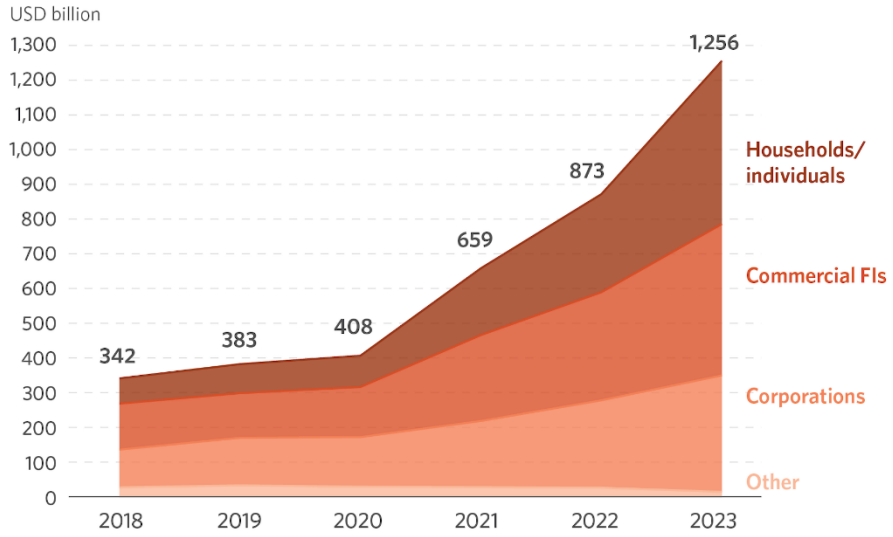
Actors within public and private markets

Within public markets, the majority of finance in 2024 was from Development Finance Institutions[1] (DFIs), government-sponsored organizations like state-owned financial institutions (FIs) and other state-owned entities (SOEs). (Climate Policy Initiative, 2025). Financial institutions, corporations and households are the biggest participants in private markets.

Figure 6: Global climate finance by public sector actors (top) and private sector actors (bottom), 2023 (Climate Policy Initiative, 2025)



Note: Other public actors include export credit agencies, institutional investors, multilateral climate funds, public funds, philanthropies and unknown actors.



Note: Other private actors include funds, institutional investors, philanthropies and unknown actors.

[1] A Development Finance Institution, is a financial institution that provides risk capital for economic development projects on a non-commercial basis. They are often established and owned by governments or nonprofit organizations to finance projects that would otherwise not be able to get financing from commercial lenders.

The role of actuaries and asset owners

Actuaries often work for asset owners (pension funds, insurers or mutual funds) or their asset managers. Significant pools of assets are owned by pension funds, insurers and mutual funds around the world - particularly in the US. Asset owners can support green investment markets either by investing directly or using their influence. Direct investment makes it easier to establish impact, but may not be possible for all investors.

When investing, asset owners and asset managers must still work within their legal, regulatory and fiduciary duties. This can limit the level of investment risk that they are prepared to take compared to, say, banks. Where they have sufficient size to diversify the additional risk or have lower liquidity requirements, they may invest directly in climate finance projects via riskier and more illiquid asset classes such as infrastructure. However, potentially lower-risk and more liquid investments such as green or ESG investment funds are a common choice.

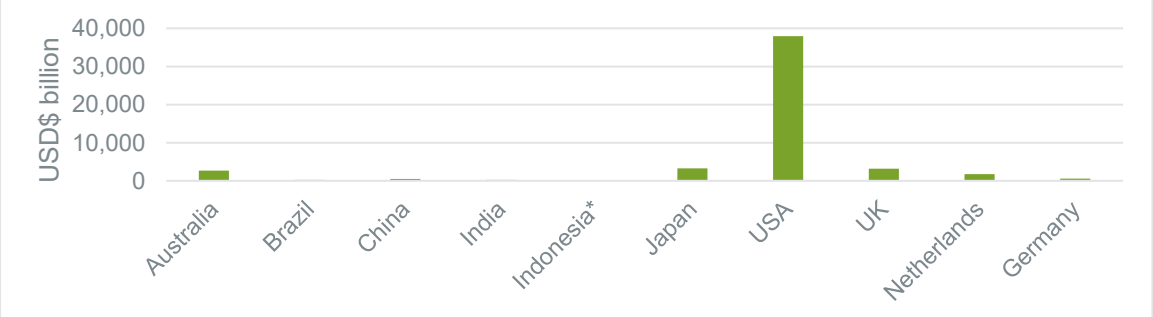
As they oversee large pools of capital, asset owners (through their asset managers) can influence policymakers and the companies that they invest in to pursue climate finance, through:

- **Engaging with companies** - shareholders (here, the asset owner) have the ability to influence the behaviour of investee companies via engagement with management and voting on resolutions. Assessing the credibility of companies' transition plans and adaptation efforts can be used to support engagement (Royal London Asset Management, 2025).
- **Demand for assets** - Stronger demand from asset owners can lead to a stronger share price, which can influence management behaviour where management incentive schemes exist. A higher share price may also make it cheaper for companies to raise capital.
- **Influencing policymakers** – financial services cannot achieve climate transition or adaptation in isolation and are dependent on the action of policymakers to enable a supportive policy environment. Asset owners can engage with policymakers to help address barriers to climate finance for asset owners and set policy which supports climate finance.

The effectiveness of the above mechanisms can be difficult to assess and is a topic that continues to be debated (e.g., divesting from high-carbon assets may not lead to real world decarbonisation).

The chart below indicates the relative size of asset owners in different counties using pension schemes as an illustrative example. There are challenges in obtaining open market data in this area and we could not find a single source for insurers or mutual funds, although the trends across mutual funds is similar to those for pension schemes.

Figure 7: Relative size of pension funds in different countries, USD$ billion, estimated year-end 2024 (Thinking Ahead Institute, 2025) **except Indonesia** (Asia Asset Management, 2025)



Australia	Brazil	China	India	Indonesia
2,639	232	480	270	23
Japan	**USA**	**UK**	**Netherlands**	**Germany**
3,300	37,992	3,139	1,747	556

Influences on green investment markets: politics, regulation and stakeholder opinion

Green investment markets are not just driven by supply and demand. They are significantly shaped by the influences of political willingness, regulation and stakeholder opinion.

Political willingness

Political willingness to support green investment markets is shaped by a complex interplay of economic incentives, regulatory frameworks and ideological priorities. Unlike other markets, green markets are more tied with these factors rather than consumer demand - whilst traditional supply and demand applies to markets such as equities, the same hasn't necessarily been seen in investment markets. Traditional markets rely on individual purchasing power and private sector enthusiasm whilst green markets often see growth linked to subsidies, tax incentives or regulatory mandates. High upfront costs and uncertainty of long-term returns without policy-driven incentives reducing attractiveness to private capital are likely to blame. As a result, policy makers' willingness to engage with sustainability efforts directly dictates the pace and scale of green market growth, reinforcing the sector's dependence on legislative action rather than market-driven forces.

Government subsidies, tax relief and direct investment - spotlight on France

Governments have the direct ability to mobilise green investment markets through green investment and subsidies or reducing the tax burden on green investment.

In 2024, the French government offered tax credits for sustainable investments which is expected to generate $22bn of investment by 2030 (Reuters, 2023).

Spotlight on sovereign green bonds

Governments worldwide have been utilising government-backed bonds (‘sovereign green bonds’) specifically designed to finance green projects.

Spotlight - Sovereign green bonds have seen significant growth in recent years, rising from 7% of the market in 2017 to over 20% in 2023 (Mastouri, et al., 2023)

Stakeholder demand

That said, stakeholder demand and opinion on sustainability does play a role in the growth of green markets to the extent that there is of course an intrinsic link between public and corporate opinion and political ideology and confidence in green markets.

Unfortunately, this is perhaps less so with respect to public opinion, than we would hope. At its core, public opinion on sustainability is itself all too often under-actioned and/or underestimated by political institutions. Studies have found most 'believe' in and support policies to tackle climate change and that the gap (named "partisan gap") between the climate views of the political left and right is smaller than people think (Ritchie, H., 2024). This misunderstanding creates further division between political ideologies, failing to represent any common agreement on the importance of climate change across the political spectrum. Ultimately, hesitancy to align policies with such public sentiment due to

economic interests, corporate lobbying or concerns over the short-term ramifications likely explains why public opinion is still not regularly reflected in policy, which could be seen inadequate in proportion to public sentiment. It is important to note that public opinion on green markets will also shift. Financial performance of green investments, media representation, confidence in regulation and robustness of 'sustainability' in the markets and associated greenwashing concerns are all influences which can shift public perception and whilst green investment markets are perhaps less market driven than traditional markets, these influences also impact corporate stakeholders and policymakers themselves.

Greater influence is had from stakeholder pressure exerted by corporate employers and their members - the latter providing the potential for public opinion to voice itself through corporate action. Evidence is increasingly suggesting that younger employees are actively changing jobs as a result of climate concerns (Clark, 2024) and investors are actively defining minimum ESG standards expected. This includes helping to develop guidance for transition plans (International Transition Plan Network, 2025). This creates a powerful incentive for businesses to invest in green initiatives as well as lobbying pressure on political parties to design policies which incentivise and encourage growth in green investment markets.

With expertise in financial modelling, assessing risk, challenging assumptions and arguably most importantly, communicating such knowledge, actuaries are uniquely positioned to add value.

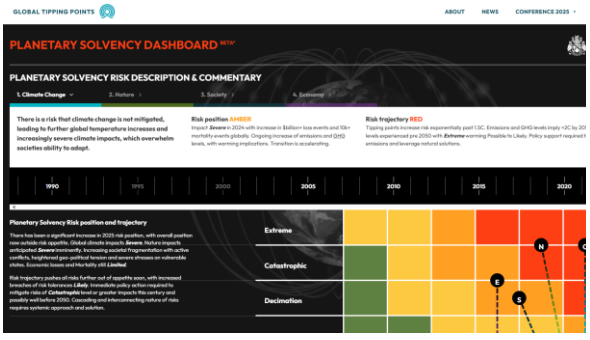
Actuarial frameworks

"Actuaries deal with uncertainty and extreme risks every day" (Trust, et al., 2024)

Actuaries should be playing a significant role in developing qualitative and quantitative frameworks for scenario analyses and financial models for implications of climate related events. This helps private markets understand their future risk landscape, proactively plan their investment strategy and challenge the assumptions underpinning their business.

Planetary Solvency Dashboard

The Planetary Solvency Dashboard was developed between the Institute and Faculty of Actuaries and the University of Exeter. This aims to provide a realistic risk assessment of climate change and frameworks to support long term policy decisions.



Actuarial challenge

With expertise in modelling long-term financial risks and uncertainties alongside challenging and communicating complex assumptions and methodologies, actuaries play a role in assessing financial viability and 'true' sustainability of green investments. Alongside other professionals, actuaries should:

- play a role in validating accuracy and reliability of sustainability reports, including transition plans, which in turn will build trust and transparency in the market.

- challenge and contribute to the definitions of environmental and social metrics.

- promote transparency and standardisation within the green investment market, in particular what 'good' looks like and how to implement sustainable investment strategies in portfolios.

Political risk and the perceived urgency of climate risk

Political willingness and growth is further hindered by reversals and policy changes when parties alternate between extremes. Most notably, the US has seen significant shifts in policies with changes in administration resulting in reversals to commitments and regulation recently. Donald Trump reversed over 125 environmental rules and policies, including withdrawal from the Paris Climate Agreement, during his first term. Then during Joe Biden's term, the US rejoined the Paris Agreement and the largest climate change investment act 'Inflation Reduction Act' in American history was signed. Now Trump has regained power and once again withdrew the US from the Paris Climate Accords (Shah, S., 2025). Polarising views and short-term focus of electoral cycles creates a significant hurdle for political parties in prioritising long-term climate mitigation strategies.

Regardless of political willingness or public opinion, perceived urgency of climate risk still falls behind reality, and green market growth has slowed recently. There is an urgent need for policy makers to adopt a more realistic risk assessment of climate change in light of inadequate measures and targets which have been employed to date (Trust, S. et al., 2025). Some argue that policymakers are underestimating the economic consequences of climate inaction, with projections showing a potential 50% GDP contraction between 2070 and 2090 unless urgent action is taken. This suggests that any short-term economic reasons for policies incentivising green investment (or not) should be far overshadowed by the risks of not taking action now. This perspective reinforces the idea that green markets are more dependent on government intervention than consumer driven-demand, making political willingness a decisive factor in their success.

Regulation

As mentioned, political willingness and policy goes hand in hand with regulation in a market. Regulation plays an important role in shaping green investment markets worldwide, influencing both the pace of sustainable development and the level of innovation in the sector. Countries with mature environmental policies, such as the EU, see greater innovation through the clear boundaries, expectations and subsequent confidence provided by regulation (Deloitte, 2025). However, a delicate balance must be struck. Whilst regulatory burdens undoubtedly increase compliance costs and limit flexibility, an excess of regulation can lead to market fatigue, hindering growth. This occurs when the cost of compliance outweighs the benefits, discouraging investment and innovation. In the realm of green investments, where market confidence is paramount to sector growth, a well-calibrated regulatory framework is crucial. This must foster confidence by providing clear guidelines and expectations, whilst simultaneously avoiding an overly burdensome approach that stifles innovation and ultimately limits the potential for sustainable development.

Factors slowing green investment growth	**Factors encouraging green investment growth**
Complex or inconsistent frameworks governing green investments can result in differing interpretations which may increase transaction costs, discourage participation or reduce confidence.	**Disclosure requirements** - government compulsion for companies to transparently report (e.g. ESG ratings on sustainability funds) makes it easier for investors to make informed decisions about green investments.
Perceived overly stringent regulation can stifle innovation and investment, particularly for smaller investment vehicles or in countries with less developed markets.	**Respected regulatory frameworks and standards** foster stability in the investment market through reducing uncertainty via providing reputable benchmarking and comparison to encourage competition. In the long run, standardising through credible certification schemes and consistent regulation saves on transaction costs and fosters mature and reliable markets.
Regulatory uncertainty - lack of clear guidelines and rules, or volatile regulation which is complex to keep up to date and adhere to, adds challenge for markets assessing long-term risks and returns. It can make comparisons unreliable, eroding investor confidence.	

Spotlight on Australia

Countries outside of the EU and UK are also being seen to lead the way in developing regulatory roadmaps for green finance.

Australia has recently updated their Australian Sustainable Finance Roadmap. While not strictly prescriptive legislation, the Roadmap acts as a regulatory framework by setting expectations, providing guidance, and influencing policy development. Through encouragement of voluntary adoption of sustainable practices, Australia is laying the groundwork for future, potentially more binding regulations (Treasury, 2024). Relating to green investment markets, the roadmap includes:

- embedding sustainability into financial practices and decision-making
- building sustainable finance markets through improved data, standards and transparency
- recommendations over mandatory climate-related financial risk and opportunity disclosures which in turn will increase market confidence
- development of a national sustainable finance taxonomy to define what constitutes a 'sustainable' investment
- creation of a labelling regime for sustainable investment products to combat greenwashing

In 2025, the Australian government began implementation of this roadmap - for example with respect to the labelling regime, noted above, via a consultation paper seeking views from investors, companies and other stakeholders on a framework for sustainable investment product labels (Chalmers, J, 2025). Chalmers states that this will 'help investors and consumers identify, compare and make informed decisions about sustainable investment products to understand what 'sustainable', 'green' or similar words mean when they're applied to financial products' and 'help investors and consumers invest in sustainable products with confidence and help tackle greenwashing'.

Other influences on green investment markets

There are many other influences on green investment markets which have not been explored in this paper. One to note is the correlation between the existence of emissions trading systems[2] and the size of green markets. Whilst this correlation is complex and there is evidence to suggest that the presence of emissions trading systems acts as a significant catalyst and accelerator for green investment markets through overlaps between the two with respect to regulatory certainty, consumer behaviour, technological innovation and investment incentives which may exist in each market. This could be an area of future research.

[2] An emissions trading system is where, to incentivise firms to reduce their emissions, a government sets a cap on the maximum level of emissions and creates permits, or allowances, for each unit of emissions allowed under the cap. Emitting firms must obtain and surrender a permit for each unit of their emissions. They can obtain permits from the government or through trading with other firms. The government may choose to give the permits away for free or to auction them.

Conclusion

There are many types of green investments and the sort of green investments countries have pursued diverge significantly. The green investment markets are still relatively immature and, as they develop, they may diverge further rather than standardising. There have been calls for standardisation of green investments in order to grow the markets and increase transparency (Network for Greening the Financial System, 2022). However, we think from our research that the diversity of the markets should not necessarily be seen as an issue. To date, it has not presented a barrier to large inflows into green investments like green bonds and secondary market funds. It has led to innovation in a range of new asset classes and availability of a diverse set of investment opportunities in international markets. Actuaries are well-placed to learn from this international innovation and to advise asset owners on how to incorporate green investments into a well-diversified global portfolio.

From our research, the further growth of green investment markets does not depend on supply and demand alone. It hinges precariously on the interplay between political will and regulation, public opinion, and the perceived urgency of climate risk. While public support for climate action is demonstrably high, translating this sentiment into effective policy remains a significant challenge. The inherent volatility of political landscapes, exemplified by the fluctuating climate policy in instances across the world, further exacerbates this instability, hindering long-term investment and innovation. Policymakers need to move beyond reactive, politically-motivated interventions and adopt long-term policy commitments that help create a consistent and predictable regulatory environment. Actuaries can influence the future growth of green investment markets by engaging with policymakers to shape a supportive policy environment for green investment, and by engaging the companies they invest with on how they support the transition and climate adaptation.

To build trust in green investment markets, and increase private sector investment, we also need robust reporting and risk assessments that accurately reflect the severity of the climate crisis and realistically assess the economic consequences of climate inaction. This is crucial to fostering the confidence needed for substantial private sector investment. When carrying out this research, it was challenging to find consistently available data and reporting. Actuaries can challenge and validate sustainability reporting on green investments and the companies that issue them to improve the quality of available reporting. They can also help to develop frameworks for measuring the financial impact of climate-related risks.

Only through such a concerted effort can we unlock the full potential of green investment markets and pave the way for a sustainable future.

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