

2025 Analysis of Climate-Related Risks in the GPIF Portfolios and ESG Controversies' Financial Impact

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Executive summary

This paper uses information derived from MSCI's analytical tools to provide an analysis of climate-related investment risks and impacts on the portfolios of the Government Pension Investment Fund (GPIF), and an analysis of controversies' financial impact using MSCI indexes. Our main conclusions are as follows:

- Analysis of climate-change-related impact using Implied Temperature Rise (ITR)
 - Our analysis indicated that, aside from the foreign equity portfolio, the GPIF FY2024 (as of the end of March 2025) portfolio-level ITR showed increasing trends across the three asset classes (domestic equity, domestic bond and foreign bond) from last year.
 - In the foreign equity portfolio, the companies with the Science Based Target Initiatives (SBTi) approved targets and voluntary emissions reduction targets increased year-over-year in carbon intensive sectors such as utilities more significantly than the other three asset classes. In the foreign equity portfolio, the utilities sector decreased their emissions overshoot faster than their allocated carbon budget. Understanding the year-over-year change in portfolio-level ITR results requires multi-dimensional analysis of corporate climate profiles from targets to materially weighted emissions.
- Analysis of climate-change-related investment risks
 - GPIF FY2024 domestic equity portfolio had the largest positive Climate Value-at-Risk (Climate VaR) under the 1.5°C Disorderly scenario due to relatively high technology opportunities offsetting relatively high policy risks. It had the largest negative Climate VaR under 3°C Current Policies scenario due to relatively high physical risk.
 - GPIF FY2024 private equity portfolio showed the lowest aggregated Climate VaR under 1.5°C Disorderly scenario, followed by 1.5°C Orderly scenario. Compared to GPIF FY24 foreign equity portfolio, the private equity portfolio's policy Climate VaR was smaller with lower security weights allocated to high-emitting sectors, such as energy and utilities.
 - GPIF FY2024 sovereign portfolio analysis is based on Phase 4 scenarios, as is the analysis of equity and corporate bond. Compared to the result of GPIF FY23 portfolio using Phase 3 scenarios, which was included in our report last year,¹ profit and loss (PnL) moved in a negative direction in NGFS Phase 4 particularly under the Net Zero 2050 scenario, since the Phase 4 scenarios reflect a more pronounced disorderly future.
- Analysis of ESG Controversies' financial impact
 - Companies with significant controversies showed weaker earnings per share (EPS) growth across market caps in Japan, compared to those without such controversies. For global peers, we observe the same trend only for the large and mid-caps.

¹ MSCI ESG Research LLC, "2024 Analysis of Analysis of Climate Change and Nature-Related Risks in the GPIF Portfolios," July 2024.

Analysis of climate-change-related risks

Status of companies' Scope 1 and 2 and some Scope 3 emissions disclosure rates

In 2024, the global average temperature rise reached a record high of 1.5°C above preindustrial levels, making it the first year to surpass the threshold set by the Paris Agreement.² Continued atmospheric warming may elevate physical risks, driving up damage and adaptation costs for the global economy. To drive corporate decarbonization in line with the Paris Agreement, governments across the world are advancing climate regulations, including the adoption of the International Sustainability Standards Board (ISSB) disclosure standards.

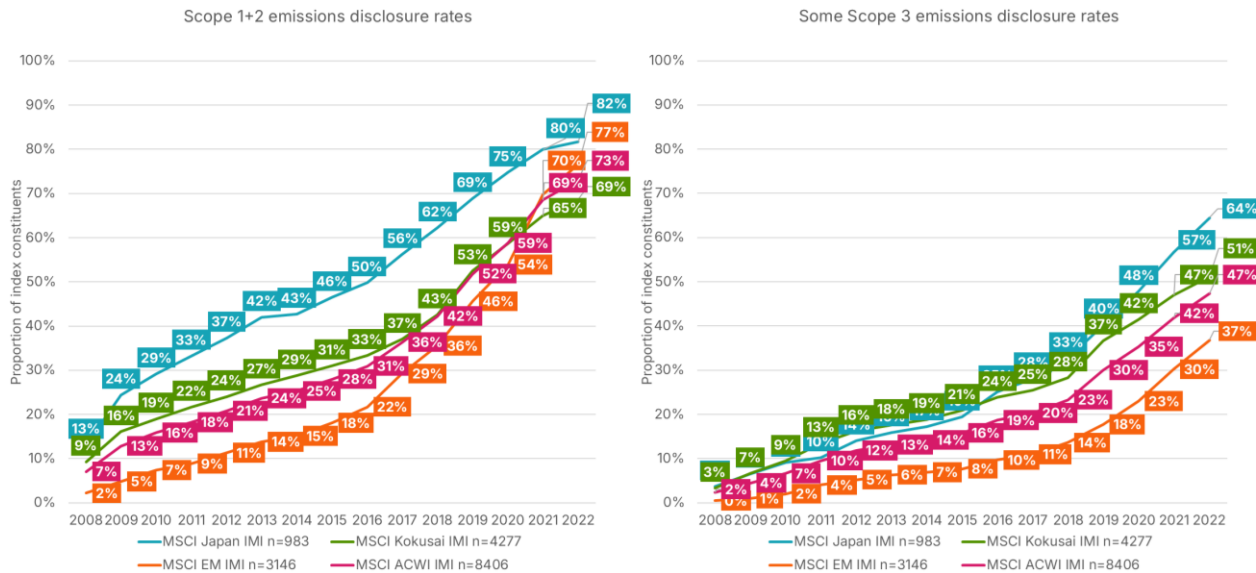
To track the progress of corporate climate-related disclosure, we analyzed how many companies have reported emissions in line with the greenhouse gas (GHG) Protocol across the four different indexes — MSCI ACWI Investable Market Index (IMI), MSCI Japan IMI, MSCI Kokusai IMI, and MSCI Emerging Markets (EM) IMI.³ Corporate emissions reporting aligned with the GHG Protocol represents a fundamental first step to planning decarbonization strategies and measuring progress.

Of the 8,406 constituents in the MSCI ACWI IMI, 73% disclosed Scope 1 and 2 emissions and 47% disclosed some Scope 3 emissions, as of June 2025 (Exhibit 1). Across the four indexes, companies in the MSCI Japan IMI showed the highest Scope 1 and 2 disclosure rates of 82%. Japanese companies increased the disclosure rates of some Scope 3 emissions by seven percentage points to 64% in 2022, from 57% in 2021, the highest increase rate across the four indexes, as of June 30, 2025. The trend could be attributed to a series of climate disclosure standards slated to take effect in the coming years in Japan, including aligning with ISSB's disclosure of sustainability metrics for securities reports.

² "State of the Global Climate 2024," World Meteorological Organization, March 19, 2025.

³ The MSCI Japan IMI is designed to measure the performance of the large, mid and small cap segments of the Japan market. The MSCI ACWI IMI captures large, mid and small cap representation across Developed Markets (DM) and Emerging Markets (EM) countries. The MSCI Kokusai IMI captures large, mid and small cap representation across DM markets, except for Japan market. The MSCI Emerging Market (EM) IMI captures large, mid and small cap representation across EM countries.

Exhibit 1: Status of Scope 1, 2 and 3 emissions disclosure rates across the four MSCI indexes



Data as of June 30, 2025. Source: MSCI ESG Research LLC.⁴

Of the 3,146 companies in the MSCI Emerging Markets IMI, 77% have disclosed Scope 1 and 2 emissions, as of June 2025, rapidly catching up with the rest of the world. Nonetheless, the companies in the emerging markets continued to lag the rest of the world for Scope 3 emissions reporting (37%).

Analysis of corporate climate target credibility

Although an increasing number of companies are setting climate targets, the likelihood to meet these targets may vary. Using several key indicators recommended by the Glasgow Financial Alliance for Net-Zero (GFANZ),⁵ we have built our own target credibility weighting system to help investors assess whether companies have taken the steps necessary to achieve their targets.⁶ The current target credibility weighting system is composed of the following four indicators:

- At least one short-term target for each Scope (e.g., Scope 1 target by 30% below 2020 level by 2030)
- At least one externally validated target (e.g., Science-Based Target initiatives (SBTi) standard)
- A track record of achieving past targets
- A current trajectory to meet at least one ongoing target

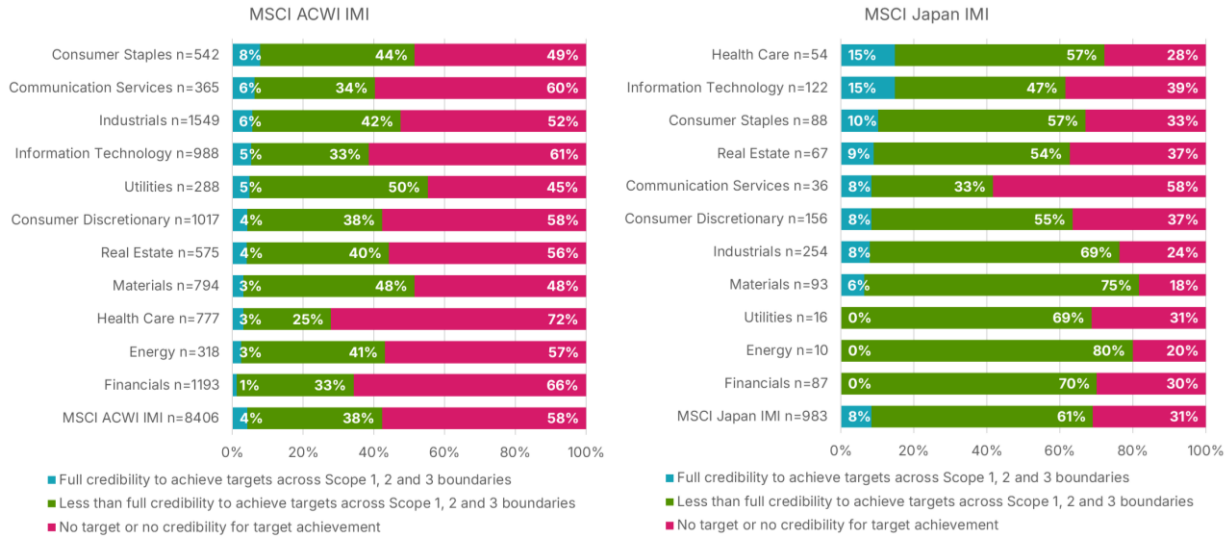
⁴ MSCI ESG and climate ratings, research and data are produced by MSCI ESG Research LLC, a subsidiary of MSCI Inc. MSCI ESG Indexes, Analytics and Real Estate are products of MSCI Inc. that utilize information from MSCI ESG Research LLC. MSCI Indexes are administered by MSCI Limited (UK) and MSCI Deutschland GmbH.

⁵ "Measuring Portfolio Alignment: Driving Enhancement, Convergence, and Adoption," GFANZ, November 2022.

⁶ For detailed methodology, see MSCI ESG Research, "Implied Temperature Rise Methodology," February 2024.

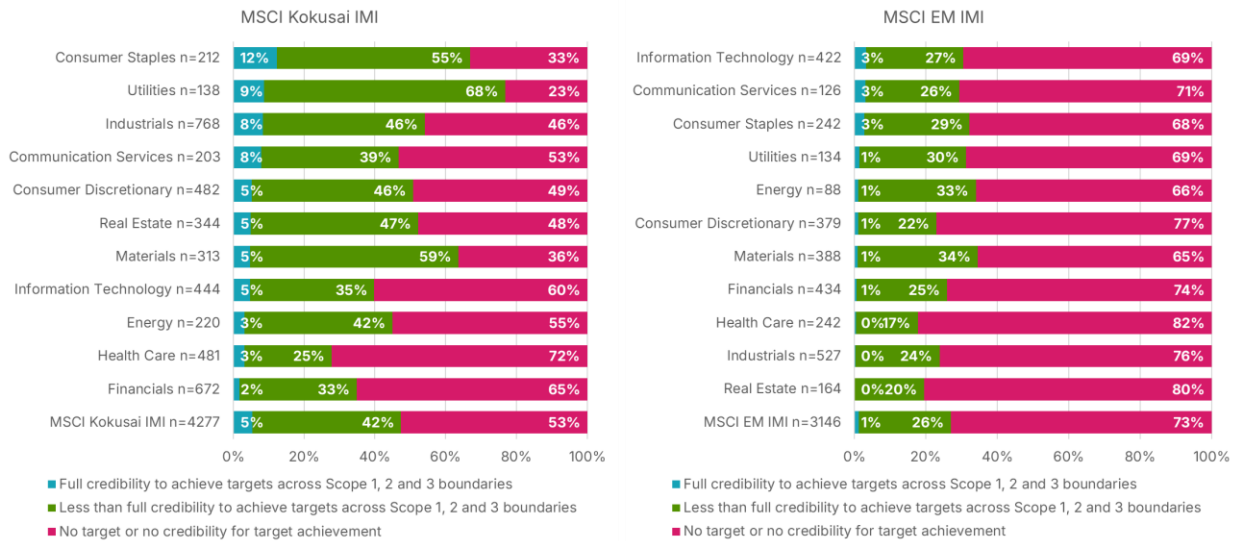
Less than 10% of constituents across the four indexes were assessed as having fully credible targets covering Scope 1,2, and 3 boundaries. The majority of them had either less-than-fully-credible targets or lacked sufficient disclosures of targets across the three scopes of emissions (Exhibit 2).

Exhibit 2: Target credibility assessments per GICS⁷ sector across the MSCI indexes



Data as of June 30, 2025. Source: MSCI ESG Research

Exhibit 3: Target credibility assessments per GICS sector across the MSCI indexes



Data as of June 30, 2025. Source: MSCI ESG Research

⁷ The Global Industry Classification Standard (GICS®). GICS is the global industry classification standard jointly developed by MSCI and S&P Dow Jones Indices.

Disparities in data availability and quality for emissions disclosure and target-setting practices underline the different starting points and market nuances across the indexes. With the ongoing rollout of mandatory emissions disclosure and target-setting standards, these differences may be reduced over time. These changes will help companies report more consistent, comparable and credible emissions data, target-setting and transition plans, all of which in turn may support climate-informed capital allocation decisions.

Impact analysis using ITR

MSCI's ITR computes the forward-looking temperature alignment of companies, portfolios and funds with global temperature goals. ITR is designed to help investors drive decarbonization in the real world by evaluating how companies and portfolios manage their "fair share" of decarbonization efforts to limit global warming.

To do so, ITR allocates a carbon budget to companies⁸ that can be aggregated at a portfolio level (Exhibit 4). The model also incorporates companies' historical behaviors through carbon budget roll over.⁹ Companies' carbon budgets are initially assigned based on the fair-share carbon budget approach reflecting companies' sectoral and regional business exposures. This initial budget is then updated every subsequent year to reflect evolving market share changes and deduct realized emissions.

The ITR model then extrapolates the global ITR at a 2100 horizon as if the global economy had the same carbon budget overshoot or undershoot as a given company or portfolio. For example, an ITR in excess of 2°C signals that company climate targets are not ambitious enough to be compatible with a 2°C world. New company targets are dynamically integrated in the ITR, which helps investors to set portfolio temperature objectives and to engage with financed companies.

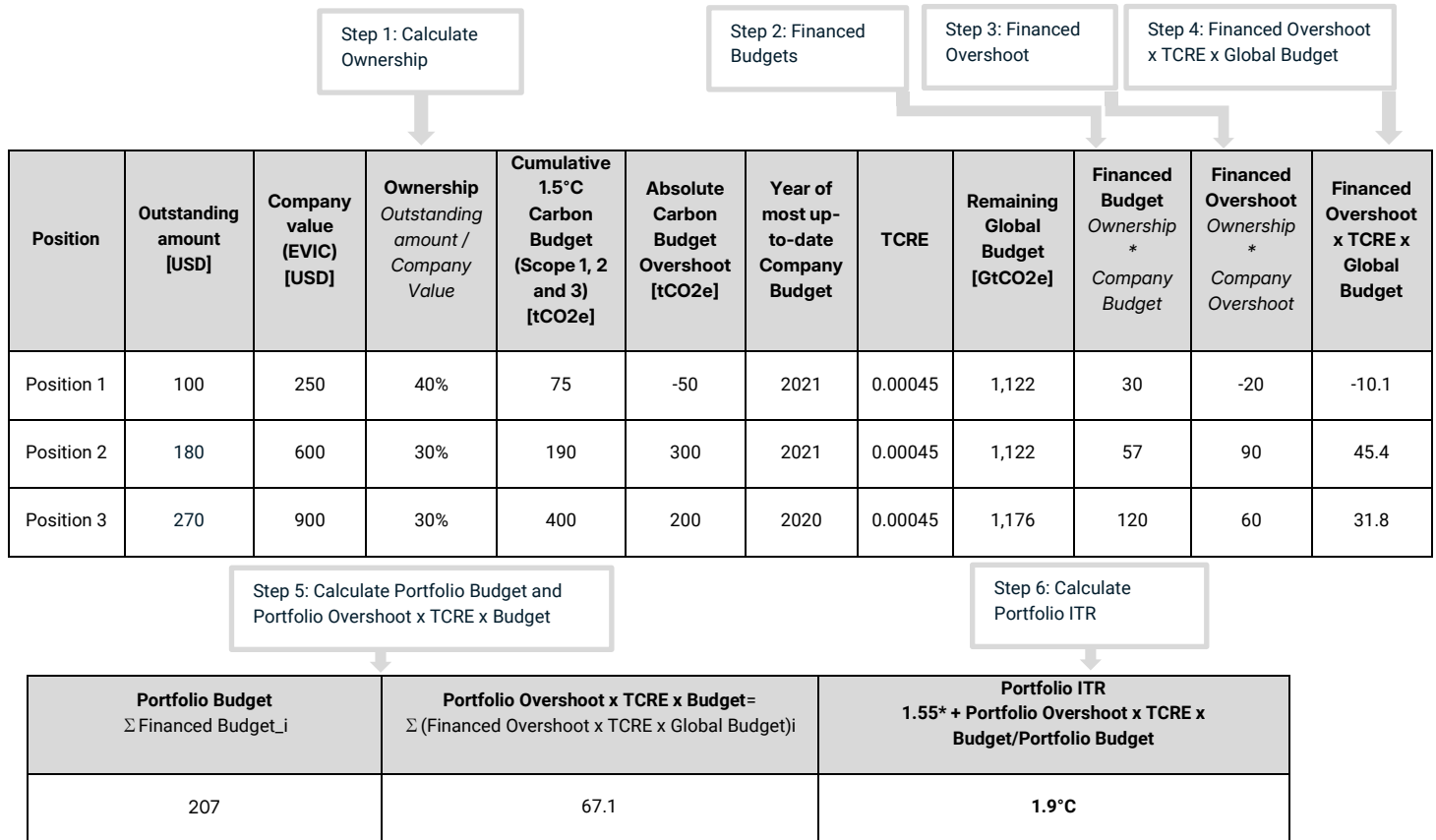
The ITR model allows the comparison between corporate climate targets at a face value (assuming they will be fully followed through and achieved) and those with target credibility assessments. Using guidance from the GFANZ Portfolio Alignment recommendations, MSCI ESG Research has developed a target credibility assessment whereby climate targets can be discounted to some extent by a credibility weight.

ITR is also well suited to disclose the alignment of financial activities with a scenario well below 2°C, as recommended by the Task Force on Climate-related Financial Disclosures (TCFD). The disclosure framework, originally developed by the TCFD, has since been adopted and further advanced by the International Sustainability Standards Board (ISSB), following the official handover of responsibilities.

⁸ The key to understanding ITR is the concept of a carbon budget, that is, how much the world can emit so that global warming does not exceed 1.5°C by 2100 and, by extension, how much a company can emit to take its fair share of global decarbonization. ITR is about extrapolating the global implied temperature rise at a 2100 horizon if the entire economy had the same carbon budget overshoot or undershoot as a given company or portfolio.

⁹ Details are documented in Implied Temperature Rise Methodology document (Client access only).

Exhibit 4: Model steps overview for calculating portfolio-level ITR



Source: MSCI ESG Research. This is for illustrative purpose, data not based on actual company information. Notes: Outstanding amount is the actual outstanding amount in listed equity or corporate bonds. It should be defined in line with the denominator. Therefore, the value of outstanding listed equity is defined based on its market value (i.e., market price times number of shares), and the value of outstanding corporate bonds is defined based on the book value of the debt that the borrower owes to the lender. The calendar or financial year-end outstanding amount should be used, as long as the chosen approach is clearly communicated and applied consistently. *1.55°C is the baseline temperature of the Net Zero 2050 NGFS scenarios. Any overshoots/undershoots of the benchmark are relative to this 1.55°C baseline.

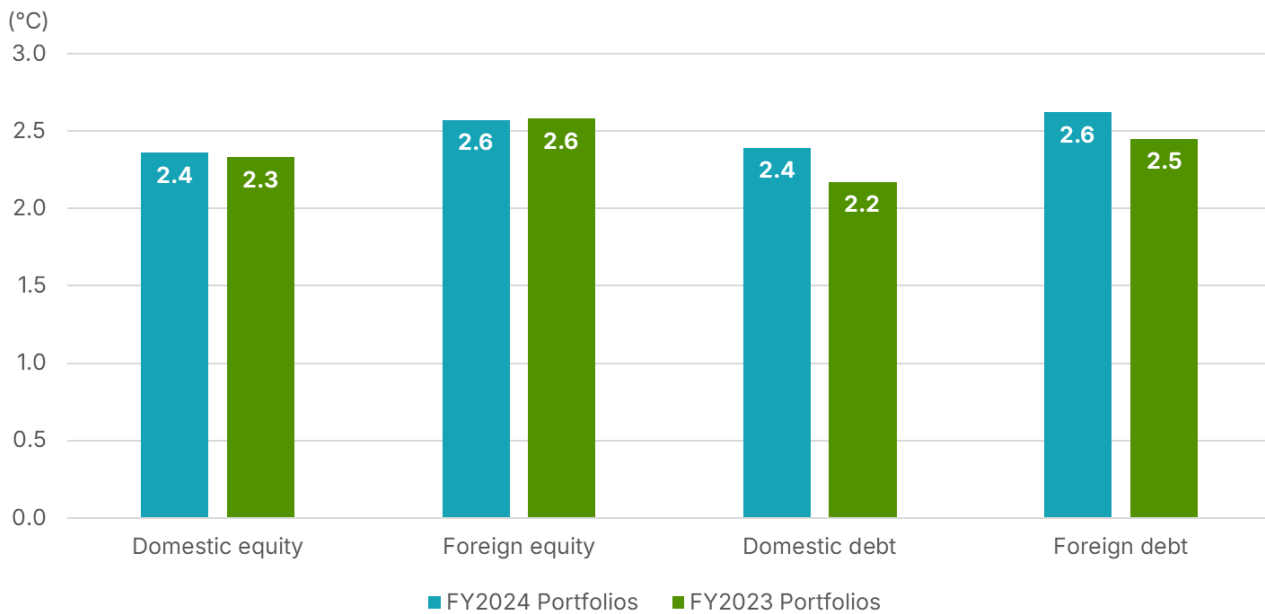
This report section analyzes the following elements:

- Comparison of the GPIF’s portfolio ITRs for each of the four asset classes (domestic equity, foreign equity, domestic bonds, and foreign bonds) between FY 2024 (as of the end of March 2025) and FY 2023 (as of the end of March 2024)
- Asset class level analysis of changes in carbon budget and emissions overshoot between the FY 2024 and FY 2023 GPIF portfolio
- Asset class level target analysis for each of the four asset classes in FY 2024 and FY 2023 GPIF portfolios

Aside from the foreign equity portfolios, year-over-year change between FY 2023 and FY 2024 in the portfolio level ITR increased across the three asset classes (Exhibit 5). We found that, **aside from the foreign equity portfolios**, the portfolio level carbon budget decreased faster than the portfolio level emissions overshoot year-over-year (Exhibit 6), which resulted in the increases in portfolio level ITR across the three asset classes.¹⁰

Carbon budget could deplete further if companies fail to implement emissions reduction initiatives and continue emitting high levels of GHGs into the atmosphere. Conversely, if more companies set climate targets and reduce emissions each year, portfolio-level emissions overshoot can be reduced more rapidly than its carbon budget is depleted.

Exhibit 5: Portfolio-level ITR results per asset class (FY 2024 and FY 2023)

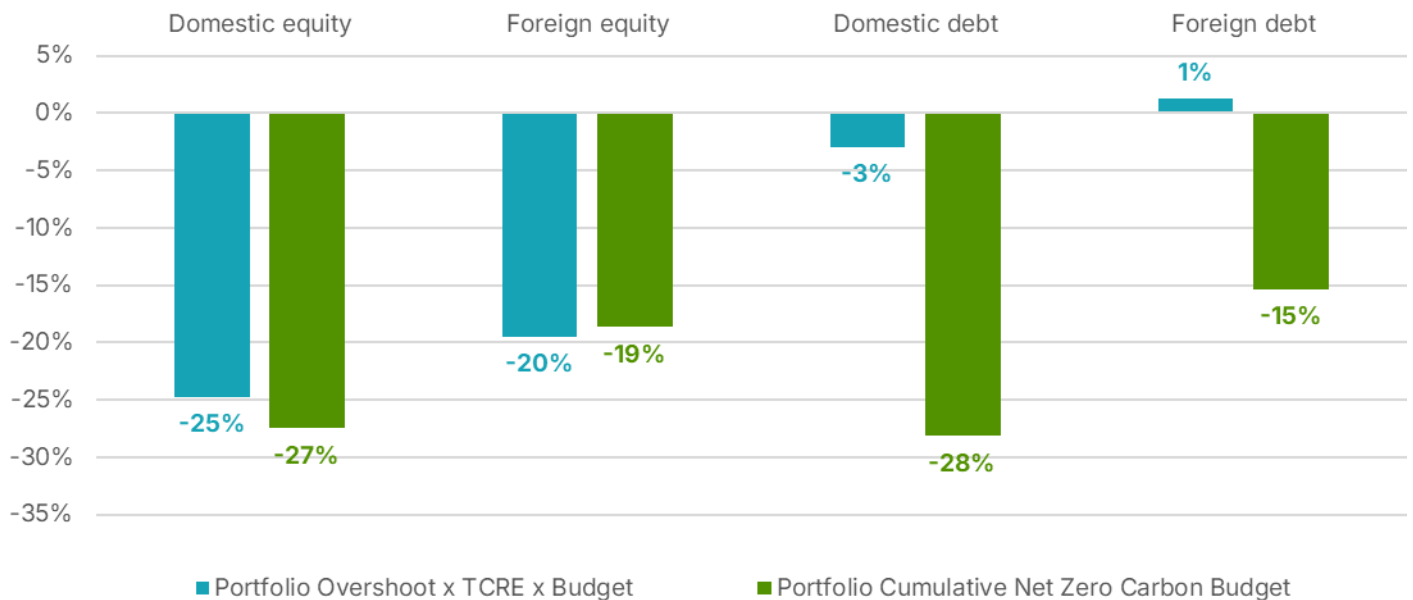


Data as of June 30, 2025. Source: MSCI ESG Research

¹⁰ Based on our methodology, the portfolio ITR increases when portfolio level carbon budget (i.e., Portfolio Cumulative Net Zero Carbon Budget) decreases faster than portfolio level emissions overshoot (i.e., Portfolio Overshoot × TCRE × Budget). Transient climate response to cumulative carbon emissions (TCRE) quantifies the global average temperature rise per 1,000 gigatons (Gt) of CO₂ emitted.

Exhibit 6: Changes in portfolio-level carbon budget and emissions overshoot per asset class (FY2024 and FY2023)

(% of YoY change)



Data as of June 30, 2025. Source: MSCI ESG Research

The share of issuers per type of climate-related targets shows the extent to which GPIF invests in businesses committed to climate actions (Exhibit 7). Companies that have not set a target or have set targets only with insufficient details¹¹ have decreased across the four asset classes between FY 2023 and FY 2024. On the other hand, the proportions of the companies that set SBTi-approved targets and emissions reduction targets with sufficient disclosure have increased across the four asset classes during the same period.¹²

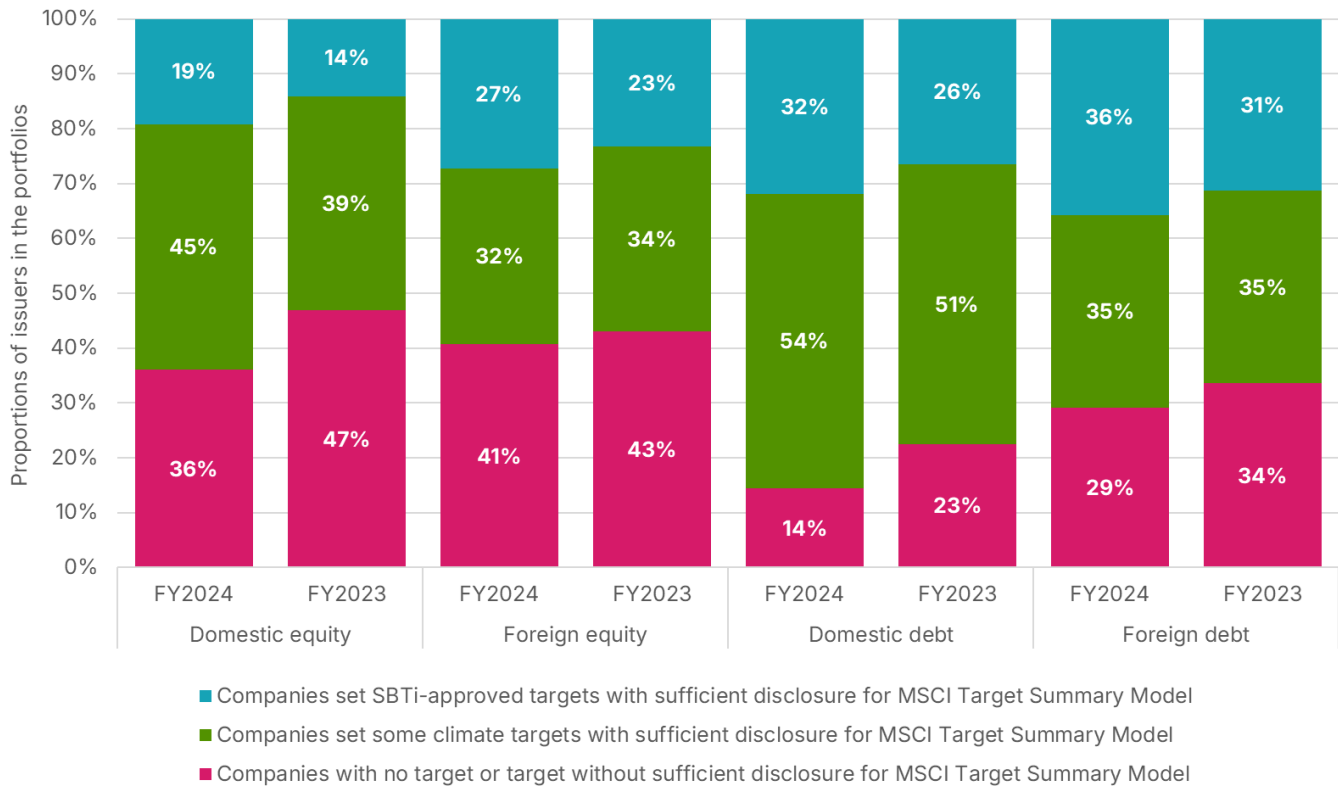
Despite a larger share of companies with the SBTi-approved targets and emissions reduction targets across the asset classes compared to last year, the portfolio-level ITR increased year-over-year for the three asset classes except for the foreign equity assets. This is attributed to the fact that the proportion of companies in carbon intensive sectors adopting these targets did not grow significantly in the three portfolios.

¹¹ Under the MSCI Target Summary Model, sufficiently granular target-level data, i.e., the following data points are required for emissions projections and progress of emissions reduction: target type (e.g., absolute or intensity target. If intensity, intensity type must be disclosed), targeted scopes and categories, emissions reduction percentages, base year and base year emissions, targeted year and targeted year emissions, reported year and reported year emissions, and coverage ratios of targeted scopes and categories.

¹² "Ambitious Corporate Climate Action," Science Based Targets, last accessed June 25, 2025. Notes: The SBTi assesses and validates corporate climate targets that would reduce their emissions aligning with the Paris Agreement goals over the near- and long-terms.

In the foreign equity portfolio, on the other hand, the proportion of the companies that set the SBTi-approved targets and voluntary emissions reduction targets increased year-over-year in carbon intensive sectors such as utilities more significantly than the others. As a result, the utilities sector companies in the foreign equity portfolio decreased their emissions overshoot faster than their allocated carbon budgets.

Exhibit 7: Changes in the proportions of issuers with SBTi-approved targets, detailed climate targets and no clear target in the total portfolios between FY2023 and FY2024



Data as of June 30, 2025. Source: MSCI ESG Research. Note: For more details on target disclosure, please refer to the MSCI Target Summary Model explained in footnote 11. This target analysis is limited to issuers within the portfolios assessed for ITR. There are several issuers included as constituents of multiple assets. Total portfolio excluded the double-count of the issuers that are part of the multiple assets when the proportion was calculated.

Climate-change-related risks for portfolios

We used MSCI Climate VaR¹³ to conduct analysis of climate-change-related risks for the GPIF's portfolios. Climate VaR provides a forward-looking and returns-based valuation assessment to measure climate-related risks and opportunities in an investment portfolio. Climate VaR provides a stressed

¹³ For details about the MSCI Climate VaR, please see [Scenario Analysis - MSCI](#)

market valuation of a security in relation to the aggregated costs and profits projections based on the transition and physical climate change by 2100. The aggregated company Climate VaR is calculated as a percentage of market value of the company or the security for a given climate scenario.

For each scenario, the aggregated Climate VaR calculates valuation impacts of an issuer arising from climate transition and physical risks and opportunities.

Transition risks and opportunities: The policy scenarios aggregate potential future policy costs. By overlaying climate policy outlooks and future emission reduction cost estimates onto a company data, Climate VaR provides insights into how the current and forthcoming climate policies may affect companies. The model integrates policy risks from direct GHG emissions (Scope 1), electricity use (Scope 2) and from value chain GHG emissions (Scope 3).

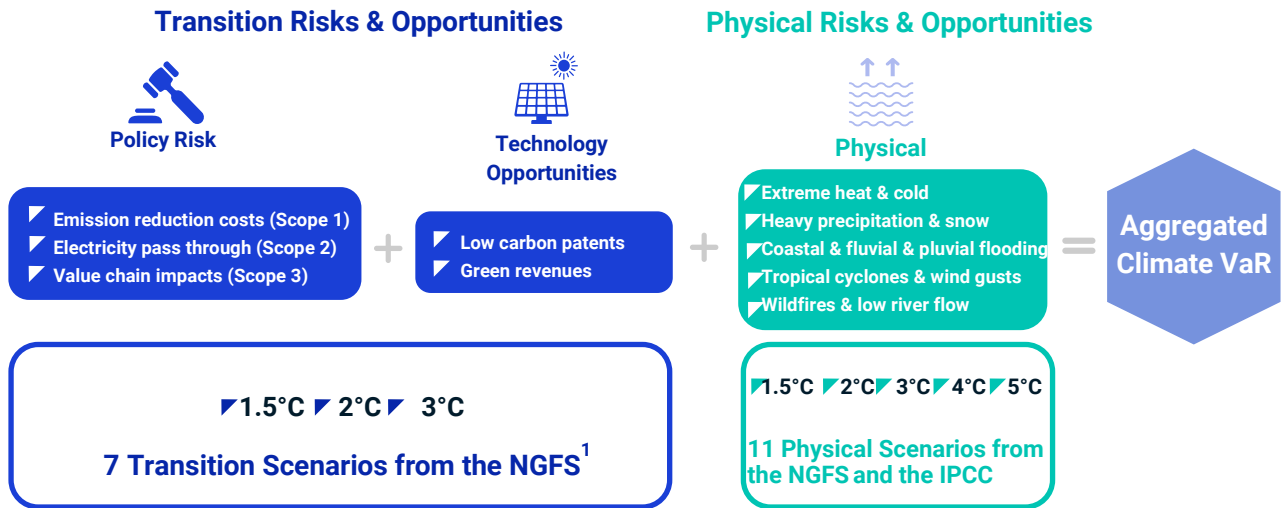
The technology scenarios identify the current green revenues and the low-carbon patents held by companies, calculate the relative quality score of each patent over time and forecast green revenues and profits of companies based on their low-carbon innovative capacities.¹⁴

Physical risks and opportunities: The physical scenarios evaluate the impact and financial risk relating to a set of extreme weather hazards, including extreme heat and cold, heavy snowfall and precipitation, wind gusts, tropical cyclones and coastal flooding.

Financial impact modeling: MSCI ESG Research translates climate-related costs into company-level valuation impacts in aggregate and its publicly tradable securities.

¹⁴ To analyze GPIF's equity and corporate bond portfolio, we used a high upside technology opportunities factor that explores alternative assumptions around profit margins and future low-carbon revenue pools. To analyze GPIF's private equity portfolio, we used a moderate technology opportunities factor as we do not provide high upside technology opportunities factor for MSCI CVaR Proxies. Regarding more details on the difference between these two factors, please see "Climate Value-at-Risk and temperature alignment: model update notes," May 2024, MSCI ESG Research. (client access only.)

Exhibit 8: Overview of Climate VaR



¹ NGFS, "NGFS Scenarios for Central Banks and Supervisors," November 2023.

While NGFS provides seven transition scenarios from Phase 4, we currently provide eight scenarios, in total, by providing the Divergent Net-Zero scenario in addition to the seven scenarios under Phase 4. While NGFS has made the decision to remove the Divergent Net-Zero from Phase 4 due to the NGFS seeing a reduced likelihood of a successful uncoordinated transition and thus a reduced usability of the scenario, we will continue to offer this scenario until further notice, but it will continue to function on Phase 3 data.¹⁵

Source: MSCI ESG Research.

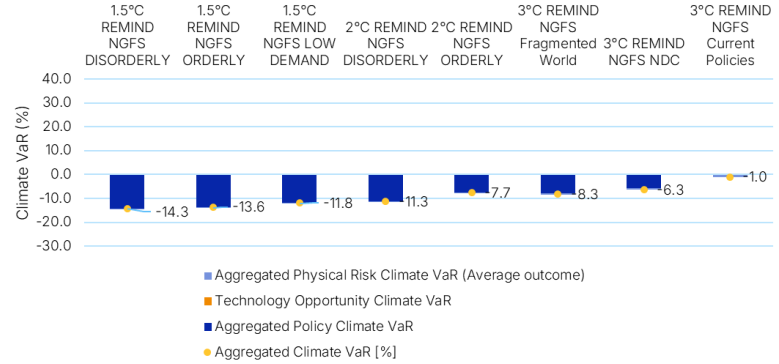
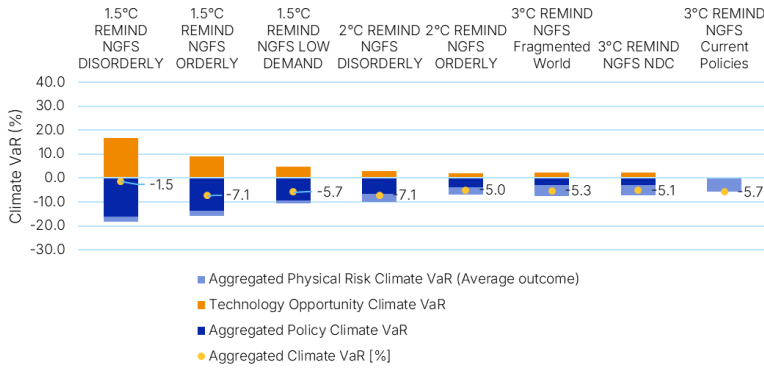
Analysis of equity and corporate bond portfolios

GPIF FY2024 domestic equity portfolio had the largest positive Climate VaR under the 1.5°C Disorderly (Divergent Net-Zero) scenario due to relatively high technology opportunities offsetting relatively high policy risks (Exhibit 9). On the other hand, it had the largest negative Climate VaR under 3°C Current Policies scenario due to relatively high physical risk. We assume there is no transition risk under 3°C Current Policies scenario.

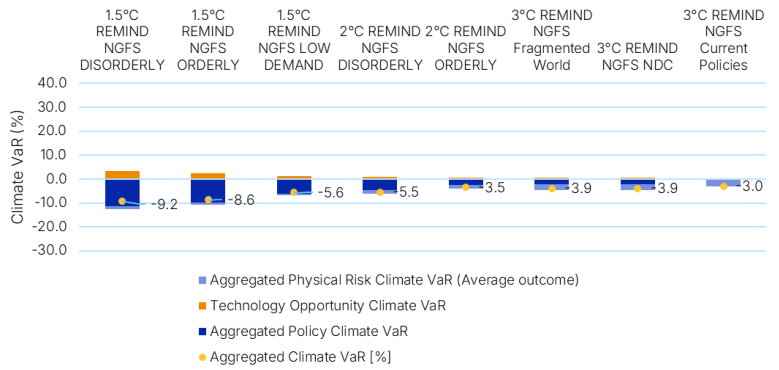
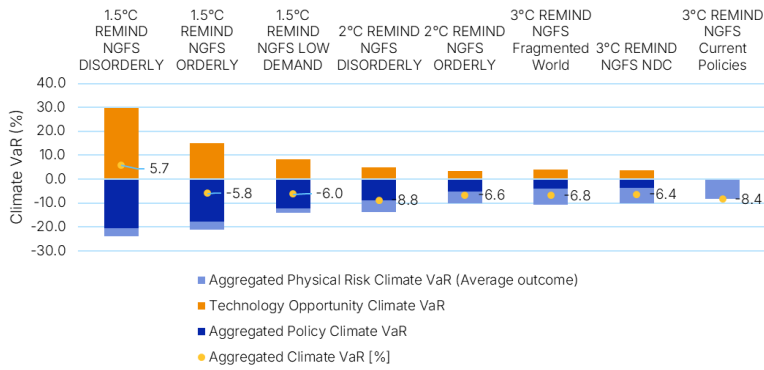
¹⁵ MSCI ESG Research, "NGFS Phase 4 Scenario Update — Corporate Climate VaR Model Results," March 2024. (Client access only.)

Exhibit 9: Climate VaR results for GPIF FY2024 portfolios

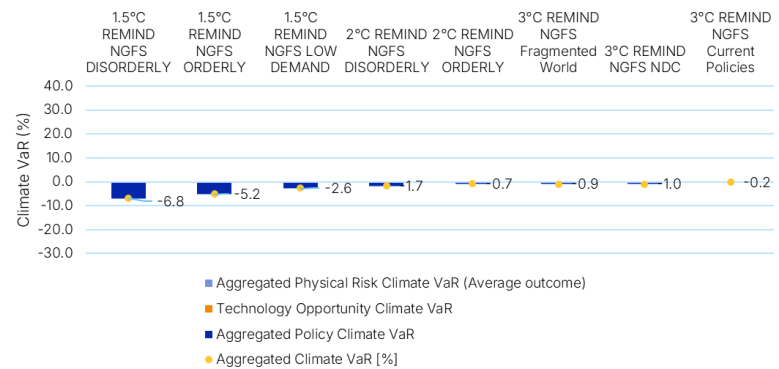
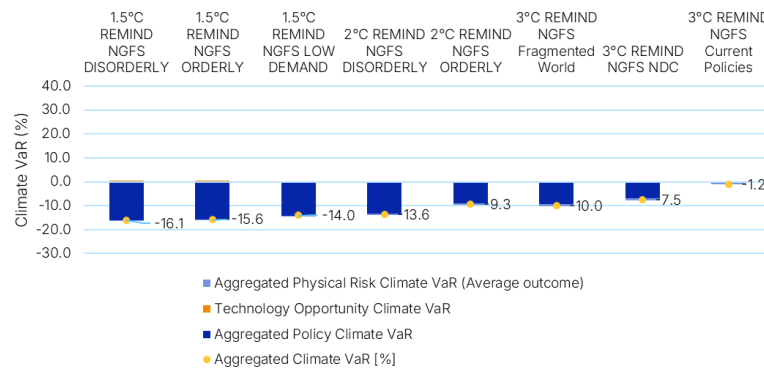
All equity portfolio (left), all corporate bond portfolio (right)



Domestic equity (left), foreign equity (right)



Domestic bond (left), foreign bond (right)



Data as of May 2025. Source: MSCI ESG Research.

GeoSpatial analysis for physical risk

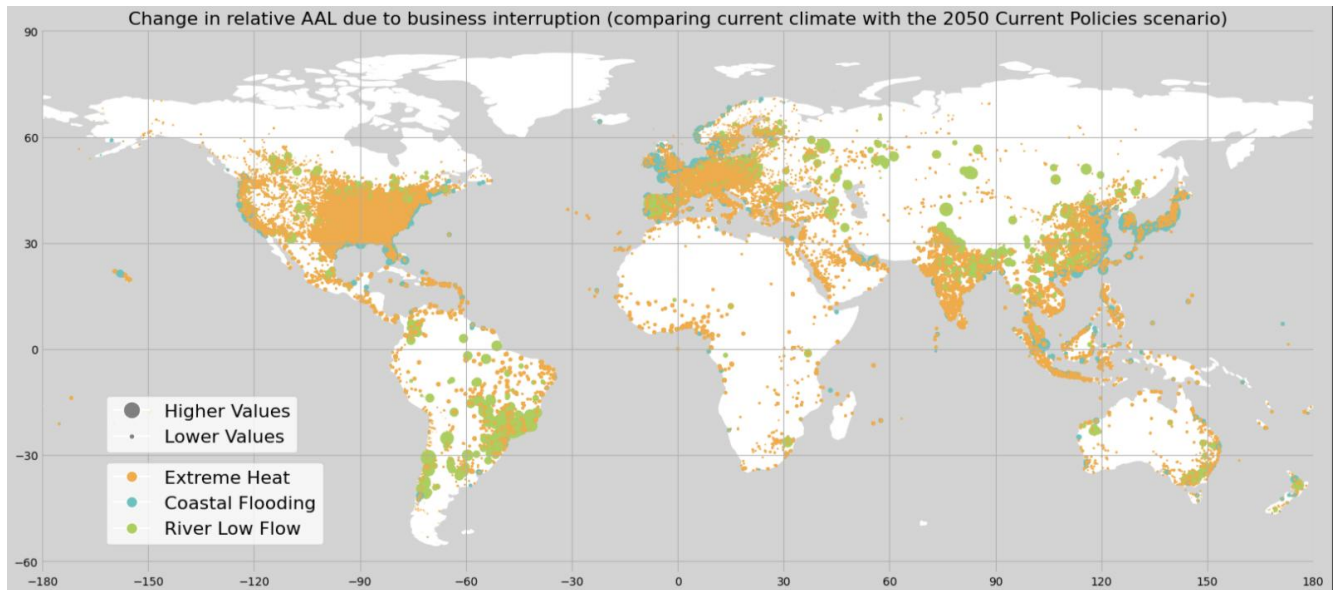
MSCI GeoSpatial Asset Intelligence is a database of approximately 2.2 million geographic locations owned or operated by around 700,000 publicly and privately held companies, as of June 30 2025. By leveraging the MSCI GeoSpatial Asset Intelligence, institutional investors can gain deep insights into physical risks from climate change and biodiversity-related risks at the individual asset level within a portfolio or loan book.

Exhibit 10 used color coding to indicate, for each asset in the equity portfolio, which type of disaster—extreme heat, coastal flooding, or river low flow—showed the largest increase in average annual loss rate. The exhibit reflected the disaster with the greatest increase in average annual loss rate between the most recent year and 2050. The size of each dot represented the magnitude of this increase.

Using assets owned by the constituents of the GPIF's equity portfolios, the Exhibit 10 analyzed a current policy scenario, which is aligned with 3°C global temperature rise. According to the GeoSpatial Asset Intelligence data used in the exhibit, extreme heat affects a wide range of assets, but the expected increase in losses was relatively small. On the other hand, coastal flooding and river low flow affect fewer assets, but the increase in associated loss for those assets was more significant.

The MSCI River Low Flow model currently quantifies risks for electric utilities. River low flow is considered one of the biggest threats to the utilities sector due to climate change as thermal power and hydropower plants contend with low water flow in river channels. Thermal power plants rely on large amounts of water for cooling and steam generation, and hydropower plants use the mechanical energy of river flow for power production. With a continued temperature rise, drought conditions leading to low river flows may become more common.

Exhibit 10: Change in relative Average Annual Loss (AAL) from business interruption, comparing current climate with projections under the 2050 NGFS REMIND Current Policies scenario



Data as of June 30, 2025. Source: MSCI ESG Research

Currently, MSCI broadly categorizes physical risks into two types: chronic risks and acute risks, covering a total of 11 types of natural disasters. When considering economic impacts, this analysis looked at two aspects related to extreme and gradual climate-related weather events:

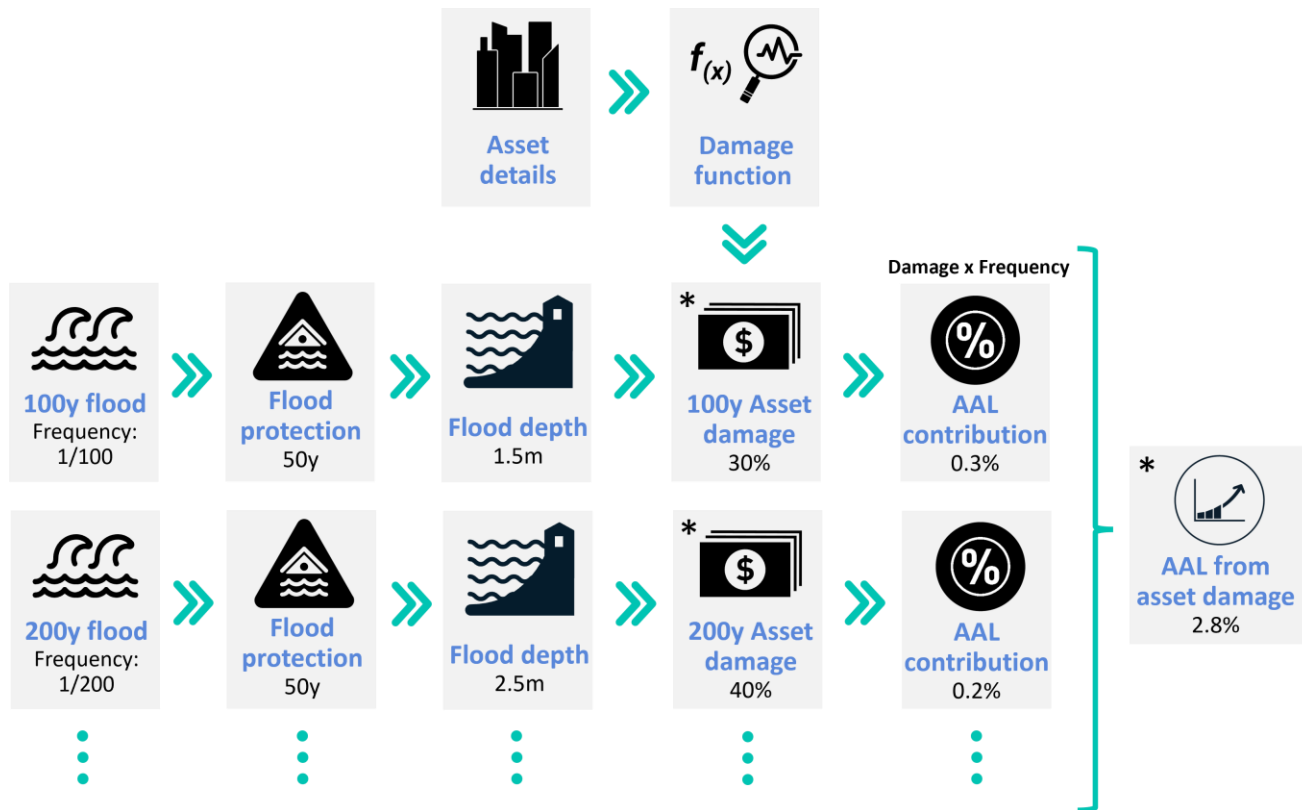
- **Asset damage:** Direct physical damage to a company’s assets at various locations of operations
- **Business interruption:** Costs associated with interruption of business operations as a direct consequence of an extreme weather event (acute risk) or due to gradual changes in revenue (chronic risk).

When calculating economic impact, this analysis used average annual loss (AAL) as a core metric. Taking flood hazard as an example, average annual losses are not based on a specific return period, but on the sum of expected losses across the entire distribution of flood frequencies. The expected loss from a flood of a given return period (e.g., a 100-year flood) was calculated by multiplying the estimated loss (e.g., 10% of fixed asset value in damage) by the probability of occurrence (e.g., 1/100). This analysis then aggregated these expected losses across the entire range of return periods to arrive at the average annual loss.

For acute risks, we estimated the average annual loss due to asset damage as a percentage of the fixed asset value of a given asset location. In addition, we estimated the annual number of days of business interruption following acute hazard events which, divided by the number of days in a year, yielded the

average annual loss due to business interruption as a percentage of the total output of a given asset location. For chronic hazards, the average annual loss from business interruption was calculated as the number of days on which a certain hazard threshold is exceeded (e.g., days below 0°C) multiplied with a factor of how much productivity is lost under these conditions.

Exhibit 11: Illustrative overview of average annual loss (AAL) calculation for acute hazards



Data as of June 30, 2025. Source: MSCI ESG Research. Notes: Outputs available in the Physical Risk – Financial Impact module.

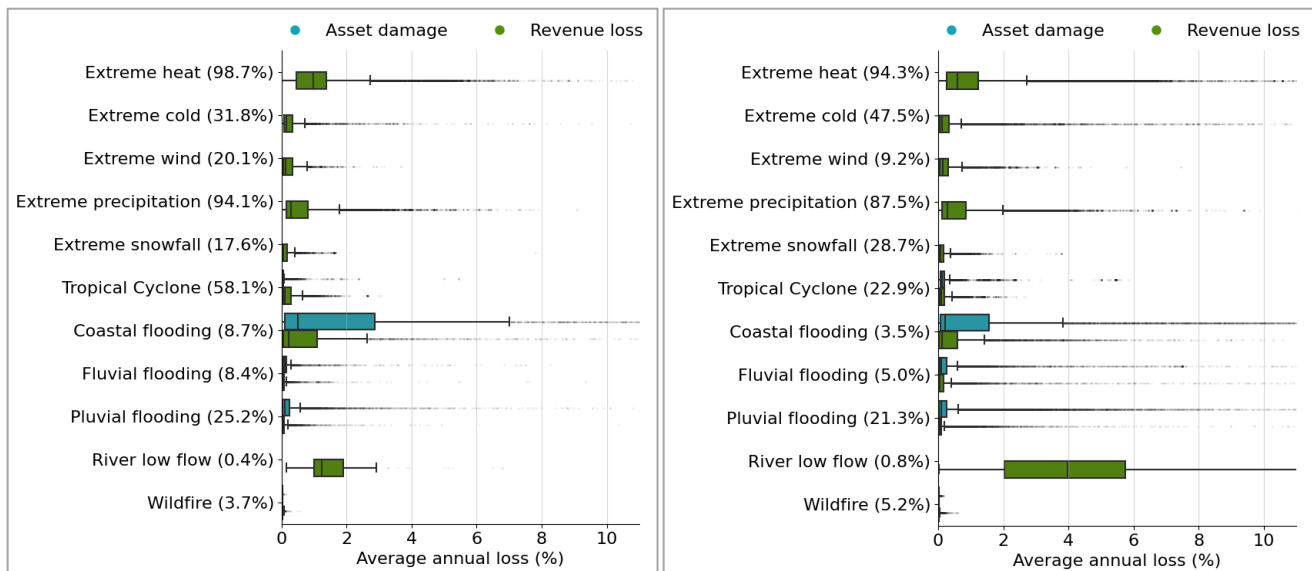
We found that coastal flooding, extreme heat, and river low flow were estimated to have the largest impacts on asset locations in the portfolio under all assessed scenarios as of the end of March 2025 for the domestic equity portfolio. Among the scenarios, these impacts were most pronounced under the 3°C scenario, reflecting a trend where higher temperature increase corresponds to more severe risks.

Our analysis also indicated extreme heat could potentially affect 98.7% of assets owned or operated by the domestic equity portfolio constituents and the average annual loss rate (AAL) associated with this hazard was relatively high (Exhibit 12). In contrast, coastal flooding affects only 8.7% of the assets, but the proportion of those affected assets with an AAL above 1% was higher than for extreme heat, making it one of the most significant physical risks for the portfolio. Regarding river low flow, the proportion of affected assets was extremely small at just 0.4% of the total portfolio. Nevertheless, the average annual loss due to business interruption for those assets was the highest among all hazards, indicating that while localized, the risk may not be negligible.

For the foreign equity portfolio, the impact from coastal flooding was estimated to be less severe and the overall risk was broadly similar to that of the domestic equities. However, we found river low flow represented a much larger physical risk within the foreign equity portfolio than the domestic equities.

While the proportion of assets affected by river low flow remained below 1% of the total assets owned or operated by the foreign equity portfolio constituents, the average annual loss rate for these assets significantly exceeded that of domestic equities.

Exhibit 12: Physical risk impact on assets and revenues in domestic equities (LHS) and foreign equities (RHS) under the 3°C Scenario in 2050

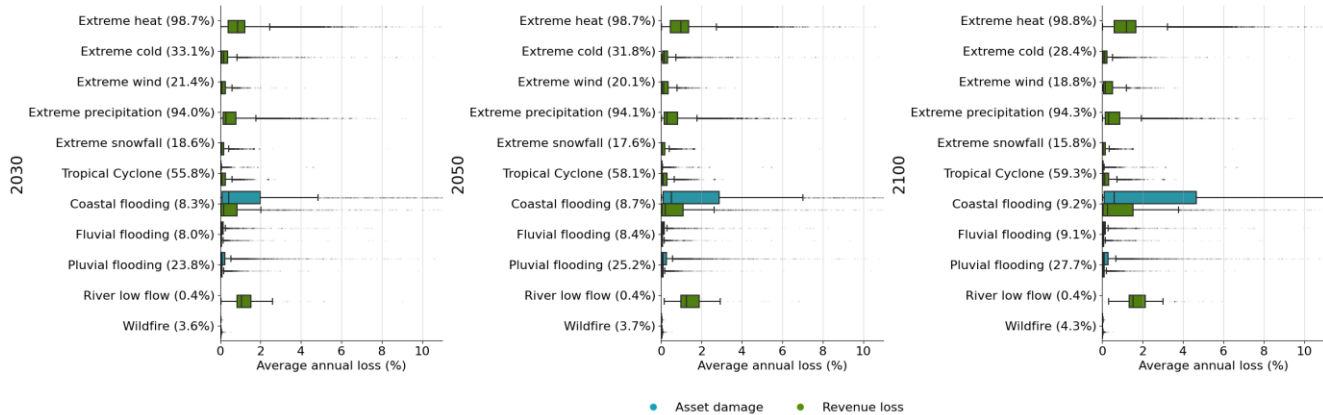


Data as of June 30, 2025. Source: MSCI ESG Research

For the domestic equity portfolio, the proportion of assets exposed to coastal flooding, which is the hazard associated with the highest average annual loss rate under the 3.0°C scenario, is projected to gradually increase from 8.3% in 2030 to 8.7% in 2050, and to 9.2% by 2100 (Exhibit 13).

We observed a similar upward trend in the third quartile (75th percentile) of AAL as the analysis period extends over the long term. This pattern was also evident across other acute physical risks, including tropical cyclones, fluvial flooding, and wildfire. This indicates that physical risk exposure is likely to intensify with rising global average temperatures and the passage of time.

Exhibit 13: Projected increase in physical risk exposure under the 3.0°C scenario for domestic equities in 2030 (LHS), 2050 (Center), and 2100 (RHS)



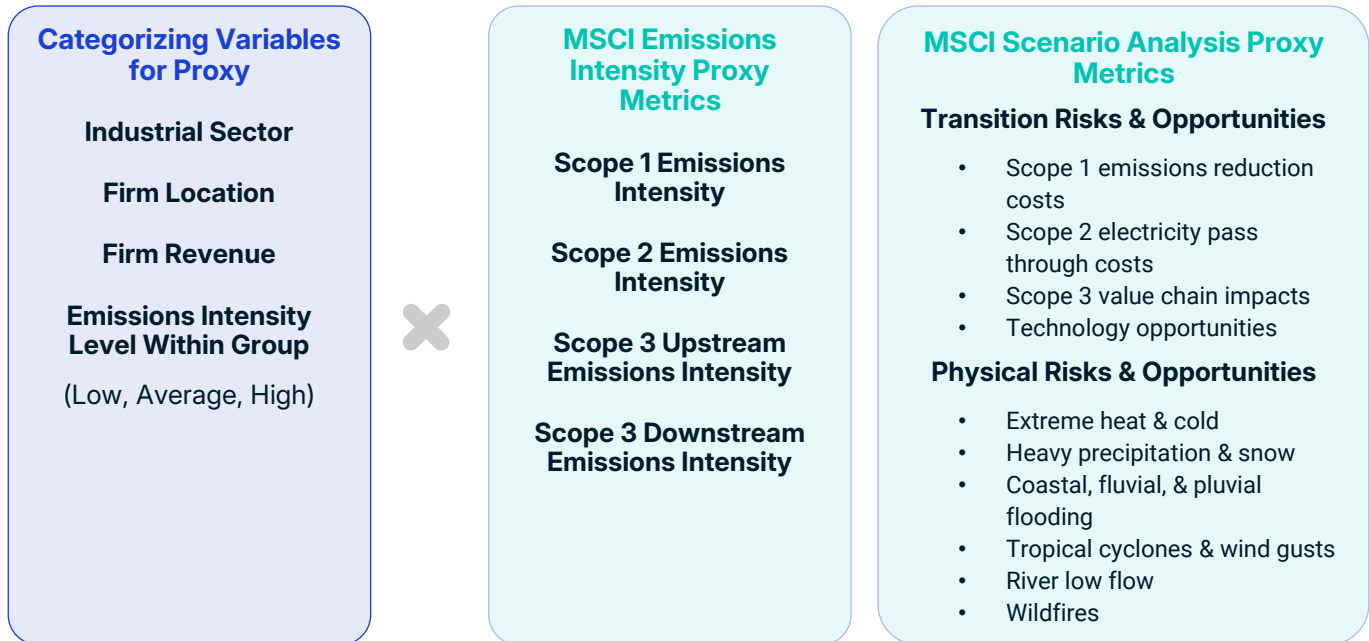
Data as of June 30, 2025. Source: MSCI ESG Research Notes: MSCI GeoSpatial Asset Intelligence provides forward-looking metrics designed to quantify how climate change could affect the exposure to physical hazards at corporate asset locations worldwide.

Analysis of private equities portfolio

We analyzed GPIF’s private equity portfolios using MSCI Climate VaR Proxies. The structure of Climate VaR Proxies is shown in Exhibit 14. For each combination of variables such as sector, region, company size, and emissions intensity level, MSCI ESG Research provides proxies for all available Climate VaR components. Our base reference dataset for Transition Risk Climate VaR Proxies comprises over 8,500 global companies in the MSCI ACWI IMI (as of February 2025). All Physical Risk modeling has global coverage and is based on MSCI GeoSpatial Asset Intelligence, which contains locations of over 40,000 publicly traded companies. Using these datasets, we create input data for Proxy Entities representing combinations of industrial sectors, global regions, emissions levels, and company size by revenue. With those input parameters, Proxy Entities are processed through the components of the CVaR model in the same manner as real companies for consistent and comparable risk assessments.¹⁶

¹⁶ For more details, please see “MSCI Climate Proxies: Climate Value-at-Risk Proxies - Methodology and Definitions,” MSCI ESG Research, May 2025. (client access only.)

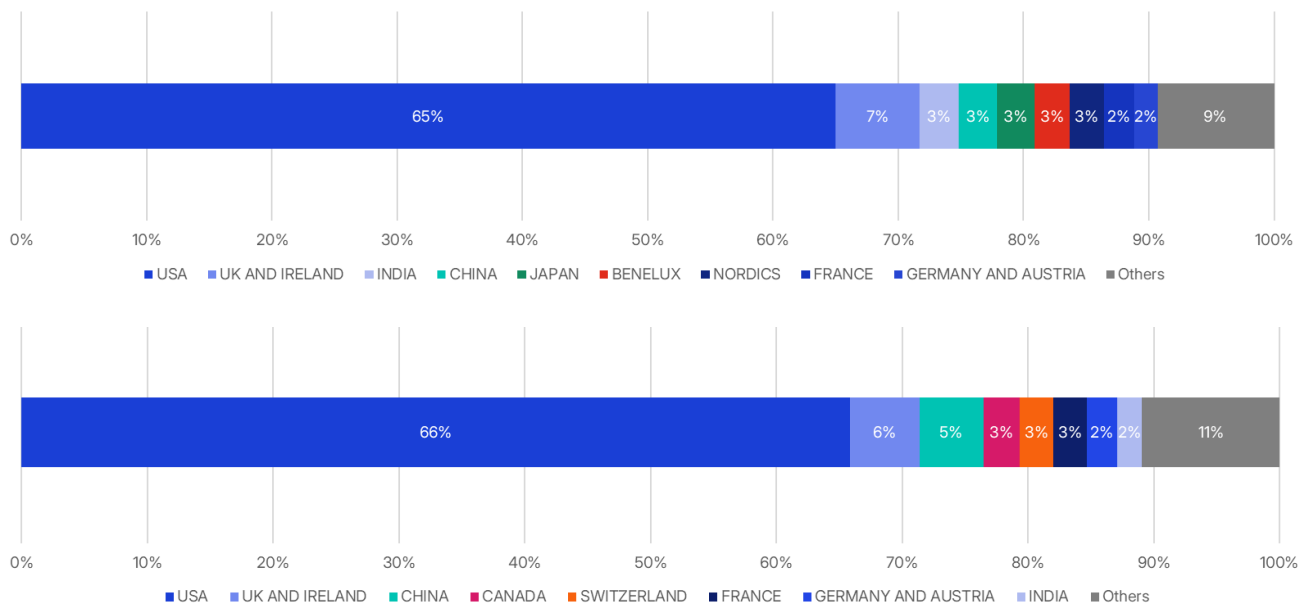
Exhibit 14: Structure of MSCI Climate VaR Proxies



Data as of March 2025. Source: MSCI ESG Research

We ran the analysis on GPIF's FY2024 private equity portfolio and compared the result with that of GPIF FY2024 foreign equity portfolio, since their regional distributions by security weights were broadly alike - both portfolios had more than 60% of its holdings in U.S. securities (Exhibit 15).

Exhibit 15: Market breakdown of GPIF private equity portfolio (top) and foreign equity portfolio (bottom) in FY 2024

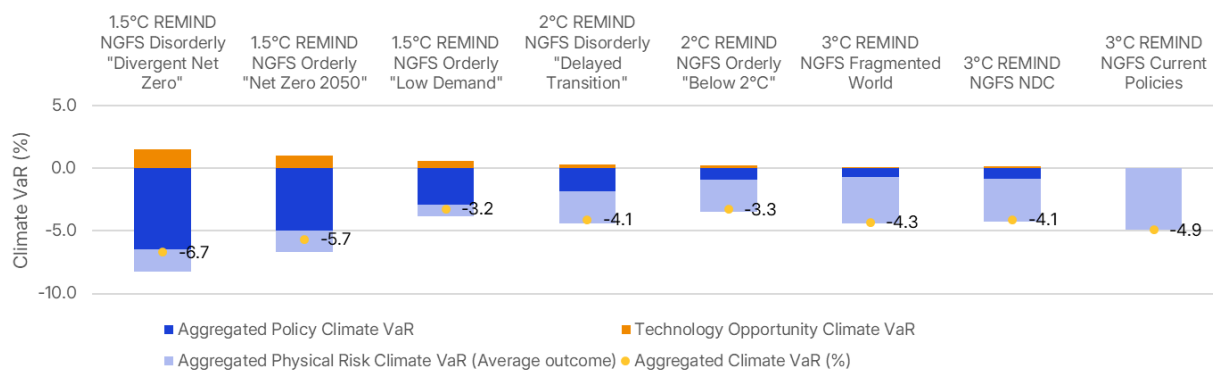


Data as of March 2025. Source: MSCI ESG Research.

The aggregated Climate VaR result of GPIF FY2024 private equity portfolio was the lowest under 1.5°C Disorderly scenario, followed by 1.5°C Orderly scenario (Exhibit 16). While we observed a similar trend in GPIF FY2024 foreign equity portfolio (see Exhibit 9), its private equity portfolio's Policy Climate VaR was smaller than that of the foreign equity portfolio. The difference in the results was driven by the difference in security-weighted sector exposure. The private equity portfolio had a lower allocation to high-emitting sectors, such as energy and utilities, compared to the foreign equity portfolio (Exhibit 17), which led to lower Policy Climate VaR.

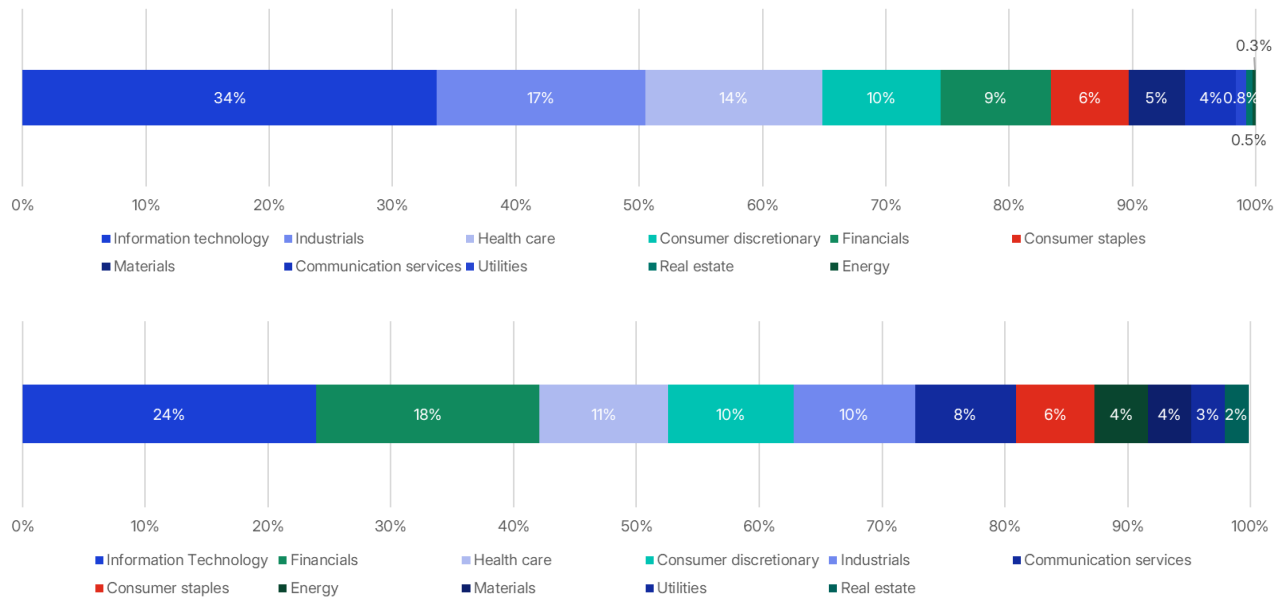
Physical risk Climate VaR of the private equity portfolio was slightly higher than the foreign equity portfolio. This difference was primarily driven by concentrated exposure within the private equity portfolio to consumer staples sector, specifically food retail industry in emerging markets that faced high exposure to physical risks, compared to the foreign equity portfolio.

Exhibit 16: Climate VaR results for GPIF FY2024 private equity portfolio



Data as of May 2025. Source: MSCI ESG Research

Exhibit 17: Security weights by GICS sector: GPIF FY2024 private equity portfolio (top) and foreign equity portfolio (bottom)



Data as of March 2025. Source: MSCI ESG Research

Analysis of sovereign bond portfolio

We analyzed the potential impact of climate change on sovereign bonds using the MSCI Sovereign Bond Climate VaR.¹⁷ The MSCI Sovereign Bond Climate VaR estimates the change in the sovereign yield curve when market expectations move from a climate-agnostic baseline expectation to any other climate scenarios. We use the framework put forward by NGFS and their scenarios for interest rates under various climate change scenarios. We used the NGFS Phase 4 scenarios for analysis on the GPIF's FY2024 sovereign bond portfolio.

Based on the NGFS scenarios, we derive potential shocks to sovereign bond yield curves and inflation curves. Using our stress testing capabilities, based on our Sovereign Bond Climate VaR model, we apply these shocks to reprice sovereign bonds. These scenarios predominantly focus on transition risks and incorporate to some extent the impact of chronic physical risks.¹⁸ Acute physical risks are not yet fully part of the macroeconomic modeling in the NGFS scenarios, therefore not considered for interest rate and inflation rate impact projections.

¹⁷ Scenarios analysis under the MSCI Sovereign Bond Climate VaR predominantly focuses on transition risks and incorporate to some extent the impact of chronic physical risks, but in the Phase 4 iteration of the NGFS scenarios, acute physical risks do not yet impact interest rate and inflation rate projections that the model relies on. The MSCI Sovereign Bond Climate VaR does not provide technology opportunities component.

¹⁸ Chronic physical risks are related to longer-term shifts in climate patterns, such as sustained higher temperatures, that may cause a rise in sea level or chronic heat waves.

The workflow:

- We base the scenarios on interest rate projections for the one- and ten-year sovereign interest rate in the NGFS scenarios. Those scenarios include a range of climate scenarios and a climate-agnostic baseline scenario.
- We calculate how today's yield curve would look if markets priced a given scenario and its interest rate projections.
- We examine the "shock" represented by the difference between the implied yield curve from a climate scenario and the baseline scenario. This reflects the shift we would observe if markets changed expectations from the climate-agnostic baseline to a particular climate scenario.
- We input this yield-curve shock into a stress test that reprices a universe of sovereign bonds. The inflation shocks are included in a similar way.

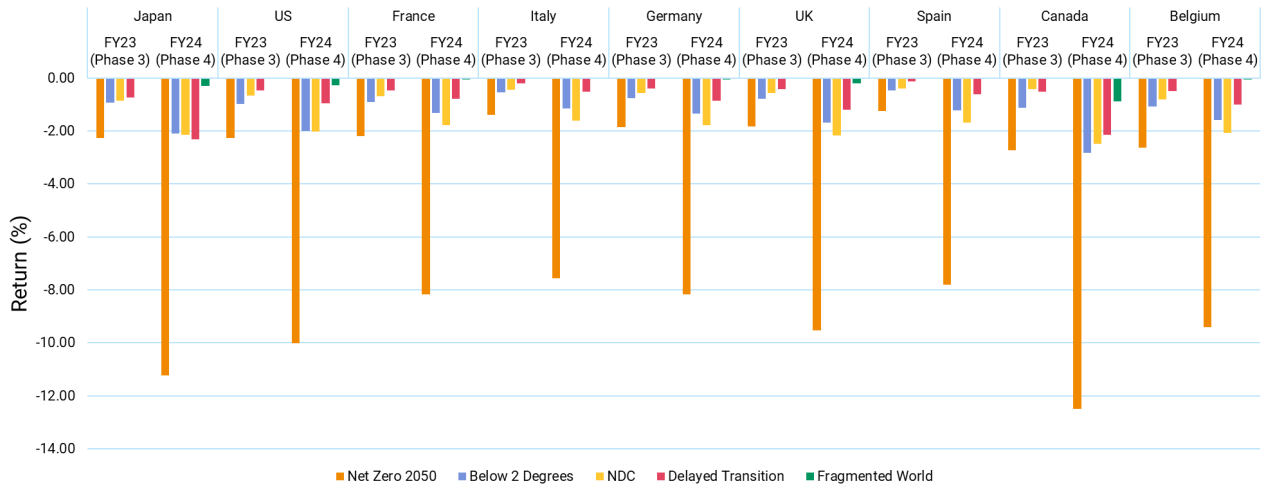
We ran an analysis for GPIF's portfolio as of the end of March 2025 (FY 2024), using Phase 4 scenarios, and compared the result with that of the FY 2023 portfolio using Phase 3 scenarios, which was included in our report last year.¹⁹

Profit and loss (PnL) moved to a negative direction in NGFS Phase 4 particularly under the Net Zero 2050 scenario. The Phase 4 scenarios reflect a more pronounced disorderly future driven by the delayed implementation of climate policies, persistently high emissions, and the impact of geopolitical volatilities on energy system trajectories. These factors have contributed to an overall increase in disorderliness of the NGFS scenarios. Disorderly scenarios capture higher transition risks due to delayed or divergent policies across countries and sectors often resulting in higher (shadow) carbon prices for the same temperature outcome.²⁰

¹⁹ MSCI ESG Research LLC, "2024 Analysis of Analysis of Climate Change and Nature-Related Risks in the GPIF Portfolios," July 2024.

²⁰ Shadow carbon prices are defined as the marginal abatement cost of an incremental ton of greenhouse gas emissions. Prices are influenced by the stringency of policy as well as how technology costs will evolve.

Exhibit 18: Sovereign Climate VaR results: FY2023 (Phase 3) vs FY2024 (Phase 4)



Note: Fragmented World scenario was newly added in Phase 4. We do not support the Low demand scenario because NGFS doesn't provide macro variable outputs for that scenario (e.g. interest rates or inflation that we need for our model). Source: MSCI ESG Research, data as of end March 2025 for FY2024 portfolio, and as of end March 2024 for FY2023 portfolio. NGFS, "NGFS Scenarios for Central Banks and Supervisors," November 2023, NGFS, "NGFS Climate Scenarios Technical Documentation V4.2," November 2023.

Analysis of controversies

We examined whether and how controversies affect the company's financial performance using MSCI ESG Controversies data. MSCI ESG Controversy Scores and Flags provide an opinion of a company's involvement in controversies and incidents related to environment, social and governance issues, per our methodology. Controversy severity is assessed based on the nature and scale of the alleged adverse impact on society or the environment. MSCI ESG Controversy Scores and the corresponding color-coded Flag are determined for individual controversy cases and consequently applied at the company level.²¹

Exhibit 19: MSCI ESG Controversies Flag scale

MSCI ESG Controversy Flag	Description
Red Flag	Companies with a Red Flag are directly involved in one or more Very Severe ongoing controversies.

²¹ For details, please see "[MSCI ESG Symbols and Definitions](#)," May 2024, MSCI ESG Research, and "[MSCI ESG Controversies and Global Norms Methodology](#)," April 2025, MSCI ESG Research.

Orange Flag	Companies with an Orange Flag may have either settled some stakeholders' concerns related to their direct involvement in a Very Severe controversy, continue to be indirectly implicated in a Very Severe controversy related to its business partners, or are directly involved in one or more Severe cases.
Yellow Flag	Companies with a Yellow Flag may have either settled most or all of stakeholders' concerns related to their involvement in Severe or Very Severe controversy cases or continue to be directly involved in one or more cases of Moderate severity.
Green Flag	Companies with a Green Flag may either be involved in one or more controversies of lesser severity or not involved in any controversies.

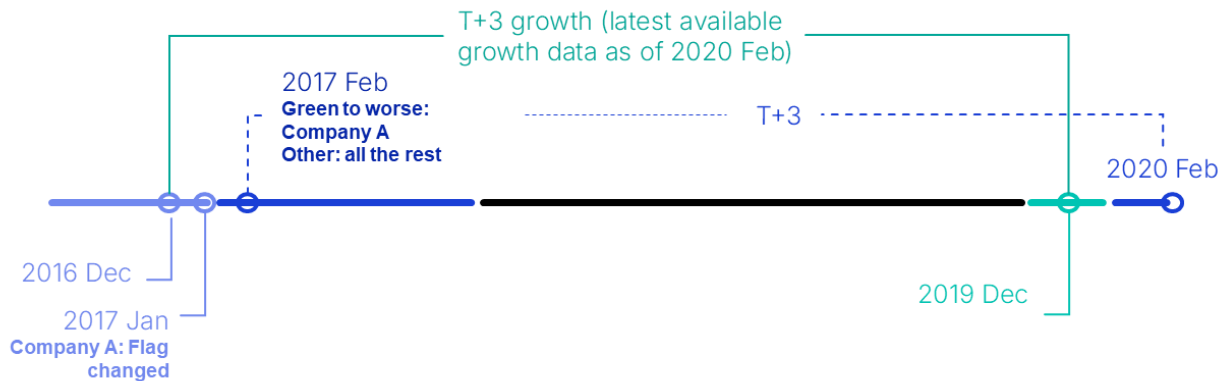
Source: MSCI ESG Research

We looked at the difference in future earnings growth between companies that faced controversies and those did not. The analytical step was as follows:

- Every month, we look at a change in controversy flag during the last month and create two buckets: one with companies of which controversy flag was downgraded from green (Green to worse) and all the rest (Other).
- In both buckets, we calculated the median of the earnings per share (EPS) trend growth rate over the next three years (T+3 growth).²² To account for potential outliers, we used the median of the growth rates over the all available months. The analysis period for Exhibit 21 was from December 30, 2016 to December 31, 2021, using the MSCI ESG controversy flag lagged by one month.²³

Exhibit 20: Illustration of analytical process to create two buckets and get T+3 growth

Example: Only company A had a flag change during the last month as of February 2017.



²² We use smoothed three-year average growth. For more details, please see "[MSCI Fundamental Data Methodology](#)," June 2024, MSCI.

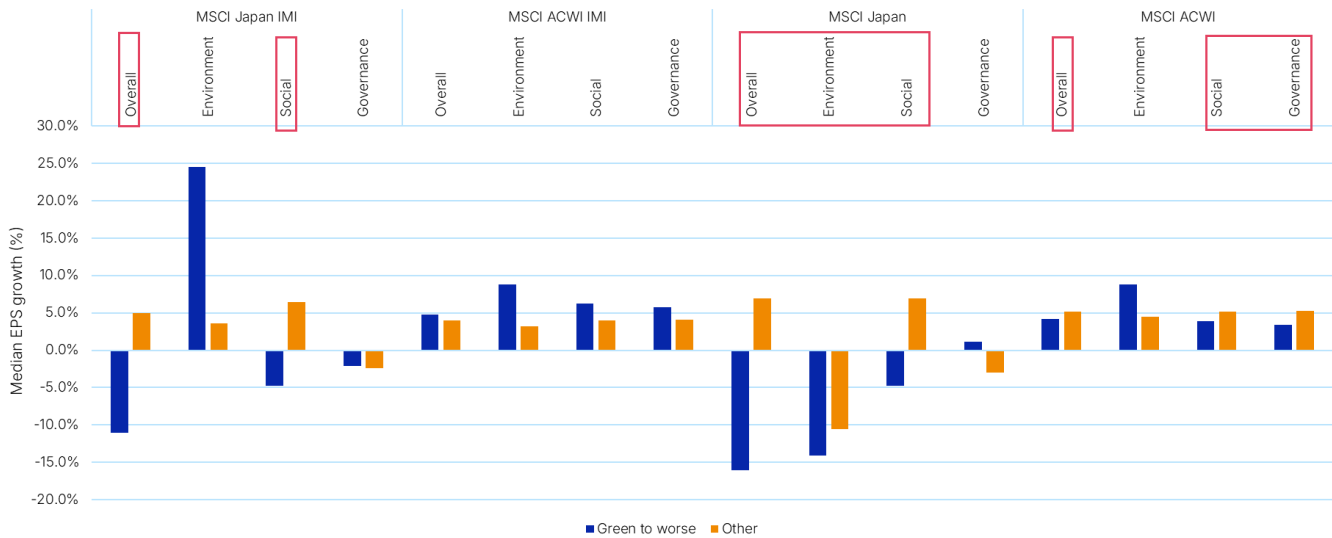
²³ Please note that for many months, the 'green to worse' bucket was empty because there were no new controversies in the coverage. Therefore, we only took into account months where both buckets were non-empty with available T+3 earnings per share (EPS) and sales per share (SPS) growth trend data.

Source: MSCI ESG Research

We found that companies that had a flag change from green to worse in overall controversy score showed a **lower EPS growth median** compared to the rest of the companies in Japan market across all market caps, as evidenced by the results for the constituents of both the MSCI Japan IMI and the MSCI Japan Index.²⁴ For global peers, we observed the **same trend only for the large- and mid-caps**, as evidenced by the results for the constituents of the MSCI ACWI IMI and the MSCI ACWI Index.²⁵

Among the results per pillar level controversy score, ESG Controversy Score in Social pillar showed the same trend for all four indexes except the MSCI ACWI IMI, whereas the results of Environmental pillar and Governance pillar were mixed. Companies that had a flag change from green to worse in ESG Controversy Score in Environmental pillar showed a higher EPS growth median compared to the rest of the companies except the MSCI Japan Index, and those in Governance pillar showed a higher EPS growth median compared to the rest of the companies except the MSCI ACWI Index.

Exhibit 21: Comparison of the median EPS growth



Data as of June 2025. Source: MSCI ESG Research

²⁴ The MSCI Japan Investable Market Index (IMI) is designed to measure the performance of the large, mid and small cap segments of the Japan market. The MSCI Japan Index is designed to measure the performance of the large and mid-cap segments of the Japanese market.

²⁵ The MSCI ACWI Investable Market Index (IMI) captures large, mid and small cap representation across Developed Markets (DM) and Emerging Markets (EM) countries. The MSCI ACWI captures large and mid cap representation across Developed Markets (DM) and Emerging Markets (EM) countries.

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