

# 2023 Analysis of Climate Change- Related Risks in the GPIF's Portfolios

MSCI ESG Research

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## Executive summary

This paper provides an analysis of climate-related investment risks and impacts from the portfolios of the Government Pension Investment Fund (GPIF), using MSCI's analytical tools. We cover issues including the state of corporate carbon emissions disclosures, target-setting, and portfolio alignment as well as investment risks for sovereign and Real Estate assets. Wherever possible, we conducted historical comparisons with past GPIF analyses and comparisons to relevant benchmarks. Our main conclusions are as follows.

**Increasing transparency regarding carbon emissions:** Using the MSCI ACWI Investable Market Index (IMI) as a benchmark, we found Scope 1 and Scope 2 emissions disclosures at 52% and Scope 3 emissions disclosure at 32% (as of June 2023). By contrast, companies in the MSCI Japan IMI showed higher Scope 1 and 2 emissions disclosures of 61% and 41% for Scope 3 emissions. While Japanese companies tended to have better emission disclosures, we note a global trend towards improved emissions reporting. This extends to Scope 3 emissions, despite challenges related to determining supply chain emissions. We attribute this upward trend in part to a series of incoming corporate climate disclosure standards across different markets.

**Corporate climate target-setting on the rise:** the UNFCCC<sup>1</sup>-mandated "Nationally Determined Contributions" have been in place since the Paris Agreement in 2015, with a requirement for member states to regularly ratchet up those commitments. Similarly, there is a growing number of companies setting climate targets on a voluntary basis.<sup>2</sup> The proportion of issuers with climate targets for target years of 2023 and beyond in the MSCI ACWI IMI rose from 6% in 2015 to 48% in 2023. Of the 9,181 constituents of the MSCI ACWI IMI, 18% had set or committed to set in the future climate targets approved by the Science Based Targets Initiative (SBTi), as recommended by a new UN agency.<sup>3</sup> When looking at the GPIF's home market, we found 65% of companies in the MSCI Japan IMI have set climate targets and the proportion of SBTi-approved targets in Japan is in line with the global average of 18%. Japanese companies tended to lag peers in other developed markets, represented by the MSCI Kokusai IMI, in which 24% of constituents had set, or committed to set, SBTi-approved targets.

**Targets gaining "credibility" in places:** not all corporate climate targets are created equal. They vary significantly in terms of scope and ambition. MSCI's Target Summary Model standardizes the assessment of such targets and projects the resulting emissions, referring to the latest guidance from the Glasgow Financial Alliance for Net Zero (GFANZ). The model incorporates target credibility assessments, which focus on the following four factors: i) short-term and long-term target-setting, ii) third party target validation, iii) track record of achieving past targets, and iv) alignment of emissions reduction progress with current targets, across each emissions scope. Few issuers achieved full credibility on all four factors. Using the target credibility factors, we have also compared companies with SBTi-approved targets (i.e., SBTi Group) and those with targets which are not approved (i.e., Non-SBTi Group). Overall, we assessed companies in the SBTi Group as having targets with higher credibility than those in the Non-SBTi Group. This suggests that companies which underwent a third-

<sup>1</sup> United Nations Framework Convention on Climate Change

<sup>2</sup> MSCI collects climate target level data from publicly available disclosures including corporate disclosures. Climate target level data includes various targets such as corporate greenhouse gas (GHG) emissions reduction targets, emissions intensity reduction targets, renewable energy procurement targets, methane leak reduction targets, and portfolio emissions reduction targets.

<sup>3</sup> United Nations' High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities. See "Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions." United Nations' High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities, November 2022.

party target-validation process tended to set more comprehensive targets and provided greater transparency into their decarbonization strategy.

**Aligning with the goals of the Paris Agreement remains challenging:** MSCI's Implied Temperature Rise (ITR) provides investors with an understanding of the extent to which companies, portfolios and funds are aligned with global climate goals, expressed in terms of degrees of warming. In 2023, MSCI updated the ITR methodology using the latest guidance from the GFANZ. Applying the updated ITR model, the proportion of so-called "Paris-aligned" companies, i.e., aligned with 2°C of warming or lower, has slightly increased in the GPIF's portfolios during FY2021 and FY2022.<sup>4</sup> This also reflects the fact that an increased proportion of companies in the GPIF total portfolio have set emissions reduction targets, going up from 63.1% in FY2021 to 65.7% in FY2022. However, collectively, these companies might not have set as clear or as ambitious emissions reduction targets to keep the global average temperature rise below 1.5°C or 2.0 °C. That is, the GPIF's total portfolio-level ITR remained stable at 2.5°C during FY2021 and FY2022, performing slightly better than the MSCI ACWI IMI at 2.6°C, but remaining misaligned with the goals of the Paris Agreement.

**Transition risks rise for sovereign bonds under the "Divergent Net Zero" scenario, but the full extent of acute physical risks under a higher temperature rise scenario remain to be seen:** in addition to ITR analysis, we conducted an analysis on the potential impact of a low carbon transition on sovereign bonds using MSCI's Sovereign Bond Climate Value-at-Risk (VaR) model. This tool estimates the change in sovereign yields when markets factor in climate risks based on certain scenarios – in this case the Network for Greening the Financial System (NGFS) scenarios, which predominantly focus on transition risks and incorporate some chronic physical risks.<sup>5</sup> When using the latest NGFS scenarios ("Phase III"), we find that the losses from transition risks are more severe than previous analyses using Phase II, for the "Divergent Net Zero" scenario, as the NGFS assumes that policy uncertainty may lead to a higher investment premium. When focusing on Japan and U.S. sovereign bonds, the highest portions of the GPIF holdings, both in Japan and U.S. bear the largest transition risks under the Divergent Net Zero scenario.

**The trade-off between physical and transition risks on real estate portfolios:** buildings are a significant source of carbon emissions mainly through their energy consumption, which may give rise to transition risks. They are also exposed to physical climate impacts, for example through extreme weather events. We thus analyzed the GPIF commercial (office, industrial, retail) and residential real estate portfolios using the MSCI Real Estate Climate Value-at-Risk (VaR). The "Transition Policy Risk" model assessed the potential cost impact from the transition to a low-carbon economy under different scenarios. The "Physical Risk" model assessed the cost of physical climate risks on buildings, using geo-localized climate data incorporating extreme heat, extreme cold, fluvial and coastal flooding, tropical cyclones and wildfire, using NGFS scenarios to compute forward-looking risks and impacts. Using the Physical Risk VaR model, the GPIF Real Estate portfolios are expected to face the lowest risk under a 1.5°C scenario and highest risk under a 3°C scenario, with coastal flooding accounting for most of risks. On the other hand, the Transition Policy VaR showed the largest impact under the 1.5°C REMIND Orderly Scenario, with the 3°C REMIND "Hot House World" being the least impactful.<sup>6</sup> This shows how stringent (1.5°C) climate policies designed to mitigate carbon emissions in the Real Estate sector could increase costs, while less stringent climate policies could result in temperature rise scenarios as high as a 3°C, posing highest physical risks through more acute and frequent extreme weather events.

<sup>4</sup> Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023.

<sup>5</sup> We note that the NGFS scenario has not yet fully incorporated acute physical risks such as coastal flooding and tropical cyclones nor it has not prescribed low carbon technology opportunity metrics, indicating that the impacts of acute physical risks and technology opportunities on the sovereign bonds were outside of scope for this analysis.

<sup>6</sup> We note that the model cannot fully predict cost allocations. For example, some transition costs may be shared with the buildings' tenants.

## Analysis of companies' climate target-level data

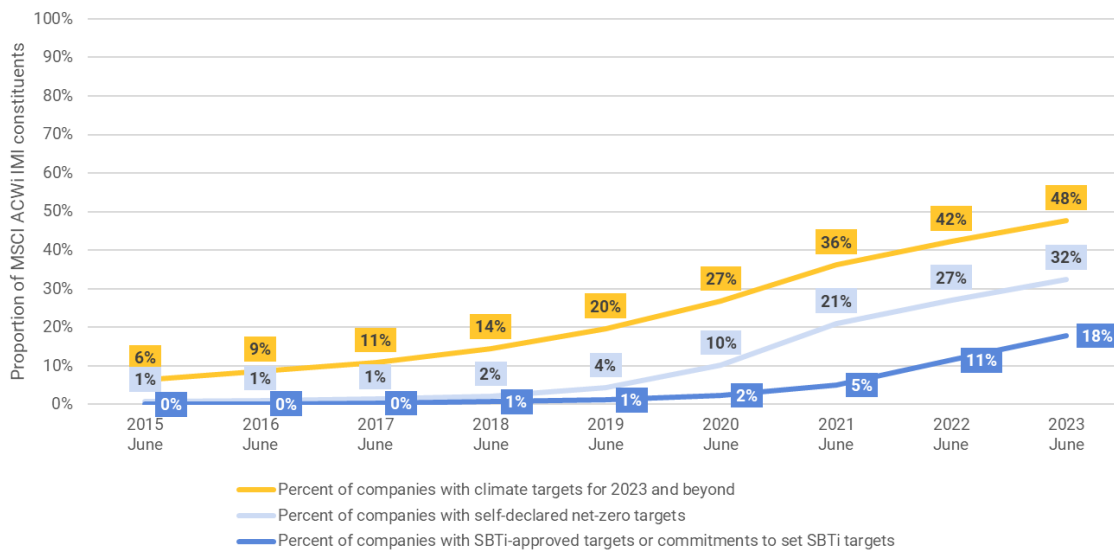
### Status of companies' climate targets based on MSCI target-level data

The Paris Agreement has required each state to communicate a nationally determined contribution (NDC) every five years.<sup>7</sup> This binding obligation on each state was characterized as the ambition-raising cycle of the Paris Agreement. The ambition-raising cycle was intended to promote progressively stronger NDCs over time and it was viewed as crucial by many states since the NDCs submitted to date were considered insufficient to meet the temperature goal of the Paris Agreement.<sup>8</sup> G7 nations also highlighted their commitments to reach net-zero emissions by 2050 in Hiroshima.<sup>9</sup>

Globally, 88 states, covering approximately 80% of global greenhouse gas (GHG) emissions, have adopted net-zero pledges, as of September 2022. This is up from 74 states in 2021.<sup>10</sup> The NDCs including these net-zero pledges, however, will not be achieved by the state actors alone; it requires a combined effort in conjunction with the private sector. Therefore, in the transition to a net-zero economy, companies may face regulatory risks centered around emissions from their business activities. Corporate climate targets can provide an indication of a company's intent to reduce its impact on climate change and minimize potential risks associated with its emissions.

This section examines the status of corporate climate target setting. Of the 9,181 companies in the MSCI ACWI Investable Market Index (IMI), an equity index that comprises the large, mid and small-cap constituents, **the number of companies setting climate targets with a target year of 2023 and later has increased to 48% from 6% over eight years during 2015 and 2023** (Exhibit 1).

**Exhibit 1: Number of companies with greenhouse gas emissions reduction targets**



Source: MSCI ESG Research LLC, data as of June 30, 2023. Refers to constituents of the MSCI ACWI IMI.

<sup>7</sup> United Nations Framework Convention on Climate Change. 2015. "The Paris Agreement, Art 14.2."

<sup>8</sup> United Nations Environmental Program. 2022. "Emissions Gap Report 2022.", D. Bodansky. 2017. "International Climate Change Law."

<sup>9</sup> Ministry of Foreign Affairs. May 2023. "G7 Hiroshima Leaders' Communique."

<sup>10</sup> Ibid.

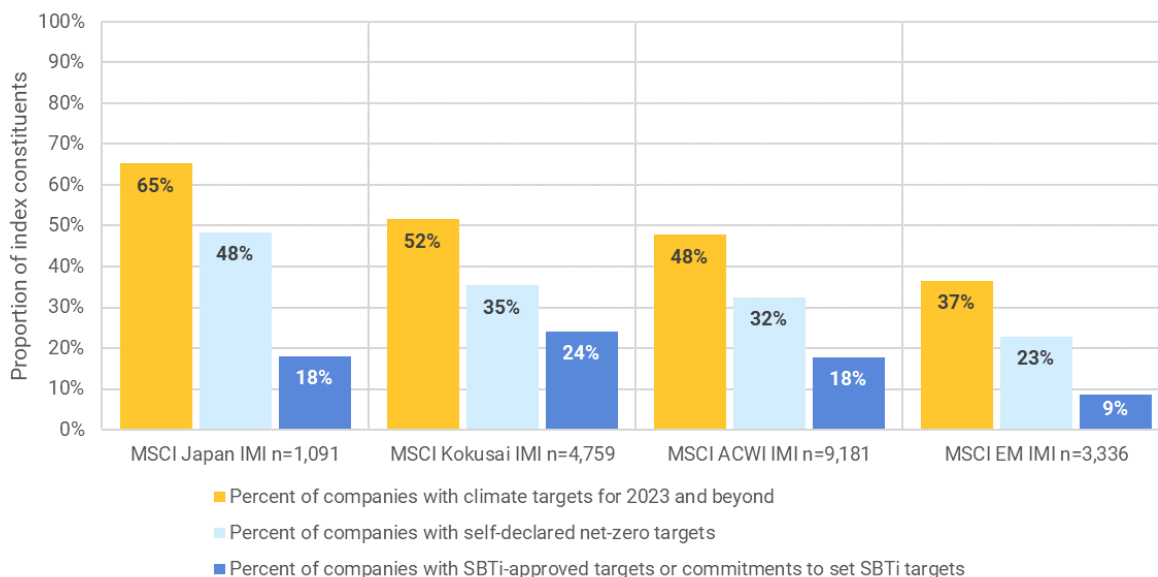
Of the 9,181 constituents in the MSCI ACWI IMI, 32% aimed to reach a state of “self-declared” net-zero, in the same time period. The rise in target setting may reflect a variety of factors, including the strengthening of NDCs and a series of both voluntary and mandatory corporate climate disclosure standards, both in effect and anticipated.<sup>11</sup>

A caveat is that self-declared net-zero targets vary in terms of their comprehensiveness and ambition.<sup>12</sup> Some aim to balance carbon emissions with carbon removal, while others do not cover companies’ complete carbon footprint or rely on carbon offsets that lack third-party validation.

Of the total 9,181 MSCI ACWI IMI constituents, 18% of listed companies had set or committed to set decarbonization targets aligned with the standard defined by the Science-Based Targets initiative (SBTi), which requires companies to set long-term targets that would reduce their residual emissions to net-zero by 2050 while aligning their reductions with a 1.5°C pathway over the near term.<sup>13</sup> A United Nations high-level expert group on net-zero commitments by the private sector recommended at COP27 that investors have their targets verified by a third party, such as SBTi.<sup>14</sup>

In Exhibit 2, we have also analyzed the status of corporate climate targets by market types, using constituents of three different indexes, namely Japan (the MSCI Japan IMI), developed markets, ex. Japan (the MSCI Kokusai IMI<sup>15</sup>), and emerging markets (the MSCI EM IMI).

## Exhibit 2: Climate target status of constituents across four MSCI Indexes



Source: MSCI ESG Research, data as of June 30, 2023

<sup>11</sup> They include the standard from the International Sustainability Standards Board, European Sustainability Reporting Standards in the European Union, and climate disclosure rules proposed by the U.S. Securities and Exchange Commission. See “ESG and Climate Trends to Watch for 2023.” MSCI ESG Research, Dec. 6, 2022.

<sup>12</sup> “The Road to Science-Based Corporate Net-Zero Target Setting.” MSCI ESG Research, September 2022.

<sup>13</sup> “SBTi Corporate Net-Zero Standard, Version 10.” Science Based Targets initiative, October 2021. Data as of March 31, 2023.

<sup>14</sup> “Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions.” Report from the United Nations’ High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities, Nov. 8, 2022.

<sup>15</sup> The MSCI World IMI excluding the MSCI Japan IMI.

We found that 65% of index constituents from Japan (MSCI Japan IMI) and 52% of constituents from developed markets outside of Japan (MSCI Kokusai IMI) had set some type of climate target. This dropped to 48% and 35% when looking at self-declared net-zero targets (Exhibit 2). This trend was reversed when looking at SBTi-approved targets, or a commitment to set future SBTi targets, with fewer Japanese constituents doing so (18% of MSCI Japan IMI) compared with other developed market constituents (24% of MSCI Kokusai IMI).<sup>16</sup>

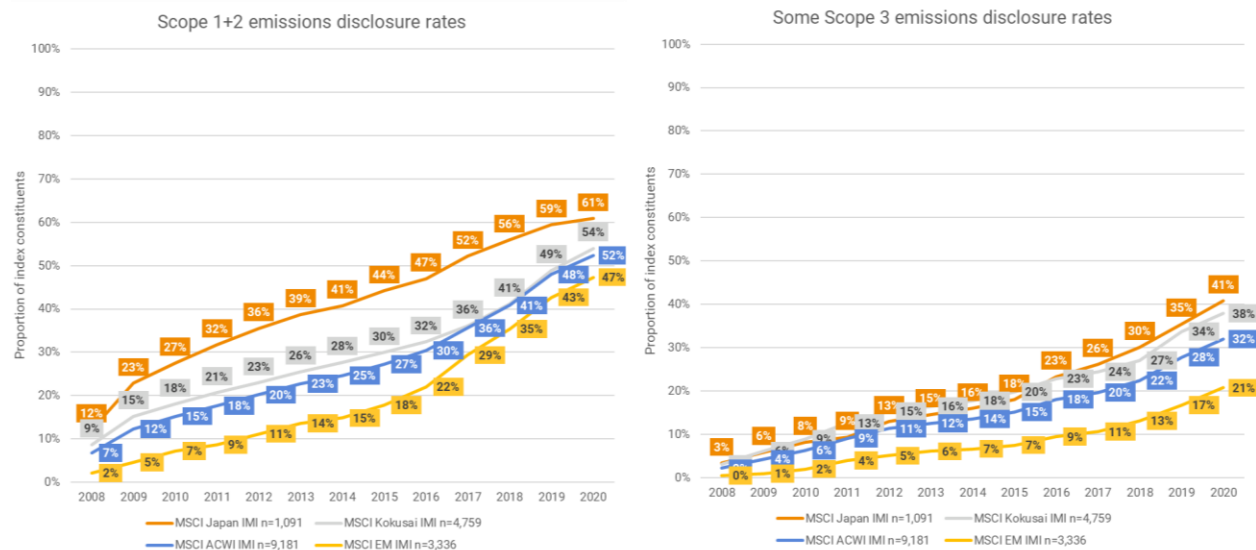
Of the 3,336 MSCI EM IMI constituents, 37% set some types of climate targets, 23% had set self-declared net-zero targets and 9% had committed to the SBTi standards. These results highlight the differences between emerging and developed markets in terms of corporate decarbonization targets.

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

For the first step of our target assessment, we analyzed how many companies have reported emissions in line with the GHG Protocol across the four different indexes – a fundamental first step to planning decarbonization strategies and measuring progress.

Of the 9,181 constituents in the MSCI ACWI IMI, 52% disclosed Scope 1 and 2 emissions and 32% disclosed some Scope 3 emissions, as of June 2023 (Exhibit 3).<sup>17</sup> **Across the four indexes, companies in the MSCI Japan IMI showed the highest Scope 1 and 2 disclosure rates of 61%.**

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



Source: MSCI ESG Research, data as of June 30, 2023

Further, **Japanese companies have increased the disclosure rates of some Scope 3 emissions to 41% from 35% between 2019 and 2020, the highest increase rate across the four indexes.** Companies in the MSCI Kokusai IMI have also increased Scope 1 and 2 disclosure rates to 54% from 49% in the same period.

<sup>16</sup> SBTi. "Company Taking Action.", last accessed on June 30, 2023.

<sup>17</sup> Greenhouse gas protocol divided Scope 3 emissions into 15 categories in accordance with Corporate Value Chain (Scope 3) Accounting and Reporting Standard. We counted Scope 3 emissions disclosures if a company reported at least one category.

These increases could be attributed to a series of corporate climate disclosure standards slated to take effect in the coming years, including the mandatory disclosure of sustainability metrics for securities reports in Japan, the SEC's proposed rule in climate-related disclosure and the corporate sustainability reporting standard (CSRD) in Europe.<sup>18</sup>

Of the 3,336 companies in the MSCI EM IMI, 47% of constituents have disclosed Scope 1 and 2 emissions, catching up with the rest of the world rapidly, as of June 2023. Nonetheless, companies in emerging markets continue to lag their developed market peers on Scope 3 emissions reporting.

## Analysis of corporate GHG emissions and climate targets by scope

Using MSCI's target-level data, we analyzed companies' emissions by scope and the rate of the companies' emissions covered by their targets, i.e., "comprehensiveness".

In a transition to net-zero economies, a company may face regulatory risks centered around its operational emissions (i.e., Scope 1 and 2). Its upstream suppliers (i.e., Scope 3) may also pass-through increased costs for sourcing carbon-intensive materials, or its downstream customers may show reduced demand for particular products based on their emissions, such as fossil fuels and conventional internal combustion engine vehicles. Hence, companies may find it helpful to align their target scopes with these potential regulatory and market risks.

Measuring the rates of emissions by scope and comparing those to the emissions coverage rate by a company's stated target allows investors to assess the potential impact such targets could provide, if met, in mitigating transition risks in a low-carbon scenario.

Exhibits 4, 5, 6 and 7 below illustrate the aggregate of sector-level emissions by scope compared to the scope of company targets and demonstrates the misalignment between the most carbon-intensive parts of companies' business activities and the scopes that their targets cover.

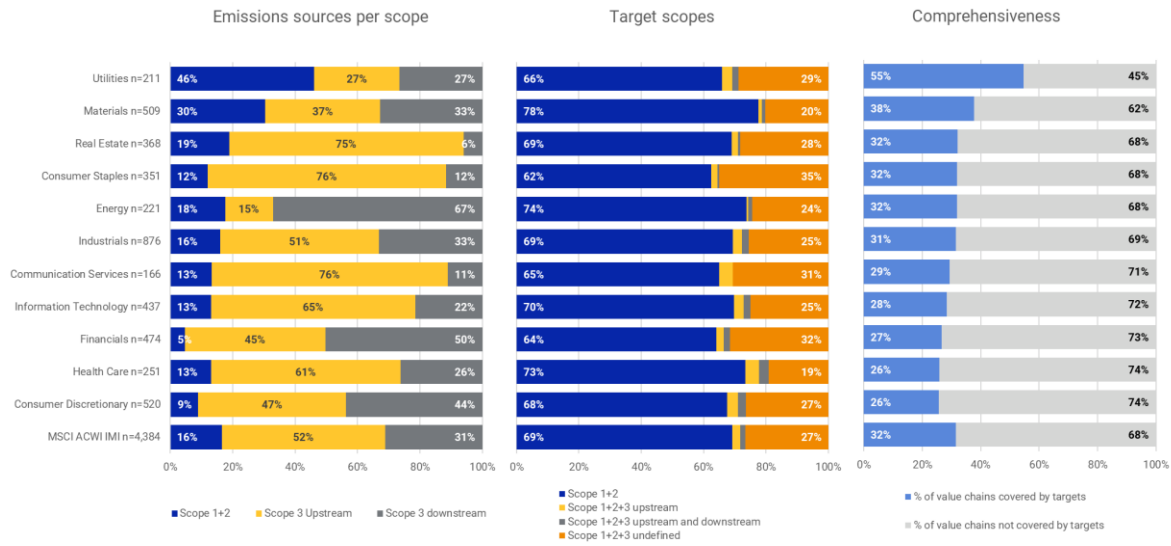
Across the four different indexes, most targets set by the utilities and materials sectors focused on their own operations, the highest-emitting business activities in their value chain, i.e., Scope 1 and 2, indicating among the highest coverage ratios by their targets. However, we found greater degrees of misalignment in other sectors. When large misalignments occur, it could imply that certain climate risks are not being disclosed or appropriately considered, elevating uncertainty around whether transition risks are being managed adequately.

Scope 3 emissions represent the largest gap. As these emissions can stem from clients and suppliers and out of direct control or risk management practices of the company, Scope 3 targets have historically been relatively rare. Developed market constituents outside of Japan (MSCI Kokusai IMI) showed the highest proportions of Scope 3 targets at 38%, compared to 31%, 24% and 20% of the MSCI ACWI IMI, MSCI Japan IMI and MSCI EM IMI, respectively.

<sup>18</sup> Financial Service Agency. November 2022. "Cabinet's order on corporate disclosure.", U.S. Securities and Exchange Commissions. March 2022. "SEC Proposes Rules to Enhance and Standardize Climate-Related Disclosures for Investors.", European Commission. "Corporate Sustainability Reporting." Last accessed, as of June 30, 2023.



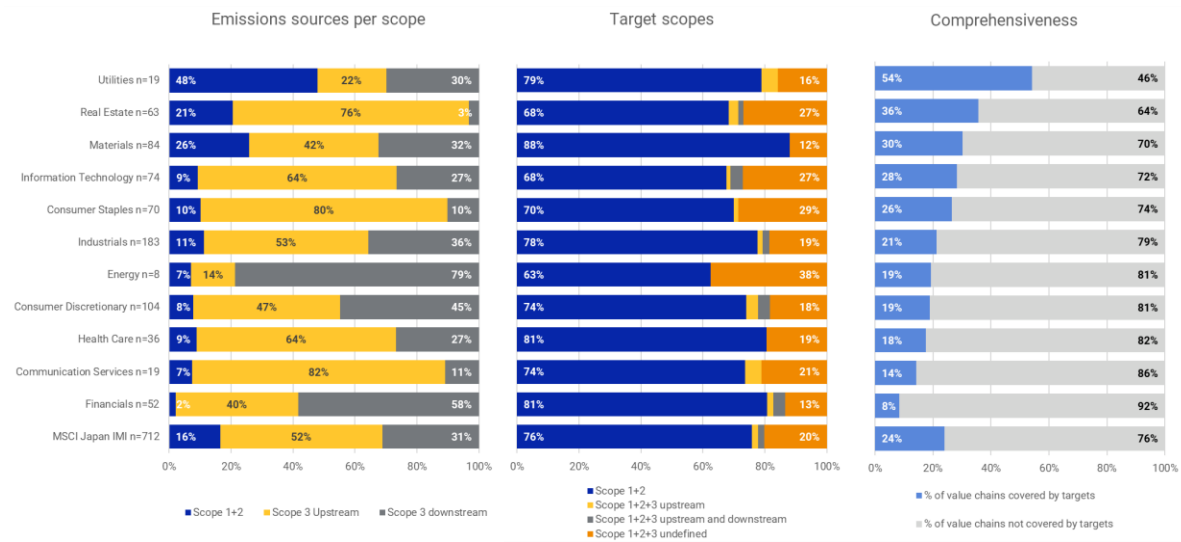
**Exhibit 4: GHG emissions and reduction targets of companies in different sectors across the MSCI ACWI IMI**



Source: MSCI ESG Research, data as of June 30, 2023. Refers to constituents of the MSCI ACWI IMI.

Notes: Chart on the left-hand side indicates average percentages of emissions from Scope 1+2 boundaries, Scope 3 upstream boundaries and Scope 3 downstream boundaries. The center chart indicates percentages of companies that aim to reduce Scope 1 and 2 emission, Scope 1, 2 and 3 upstream emissions, Scope 1, 2 and 3 upstream and downstream emission and Scope 1 and 2 and undefined categories of Scope 3 emissions in the final target year. Chart on the right-hand side indicates average percentages of total emissions covered by targets in each sector of the Global Industry Classification Standard (GICS®).<sup>19</sup>

**Exhibit 5: GHG emissions and reduction targets of companies in different sectors across the MSCI Japan IMI**



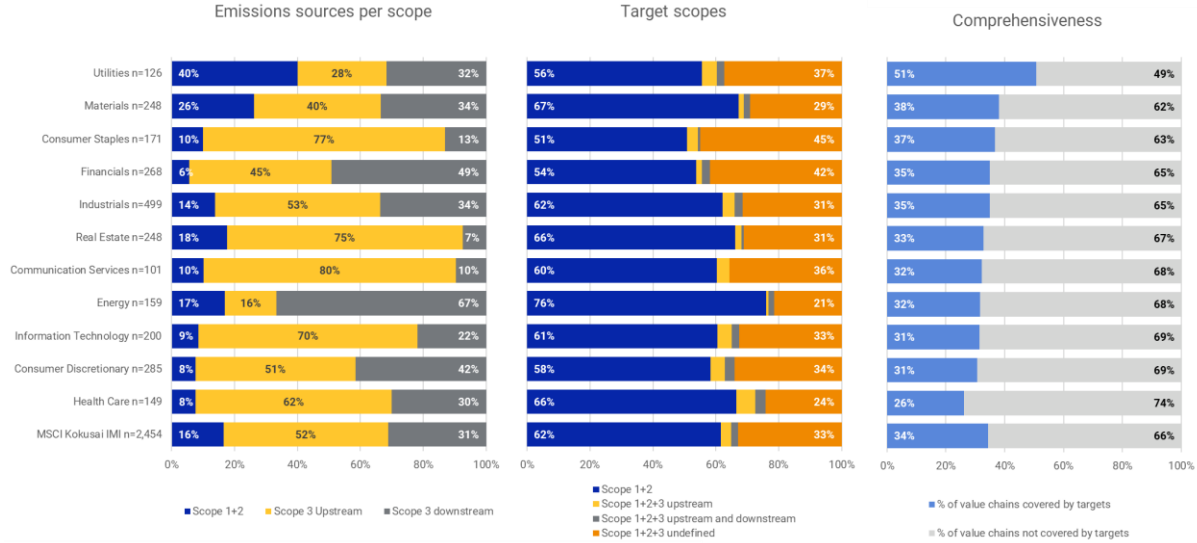
Source: MSCI ESG Research, data as of June 2023. Refers to constituents of the MSCI Japan IMI.

Notes: Chart on the left-hand side indicates average percentages of emissions from Scope 1+2 boundaries, Scope 3 upstream boundaries and Scope 3 downstream boundaries. The center chart indicates percentages of companies that aim to reduce Scope 1 and 2 emission, Scope 1, 2 and 3 upstream emissions, Scope 1, 2 and 3 upstream and

<sup>19</sup> GICS is the global industry classification standard jointly developed by MSCI and S&P Global Market Intelligence.

downstream emission and Scope 1 and 2 and undefined categories of Scope 3 emissions in the final target year. Chart on the right-hand side indicates average percentages of total emissions covered by targets in each GICS sector.

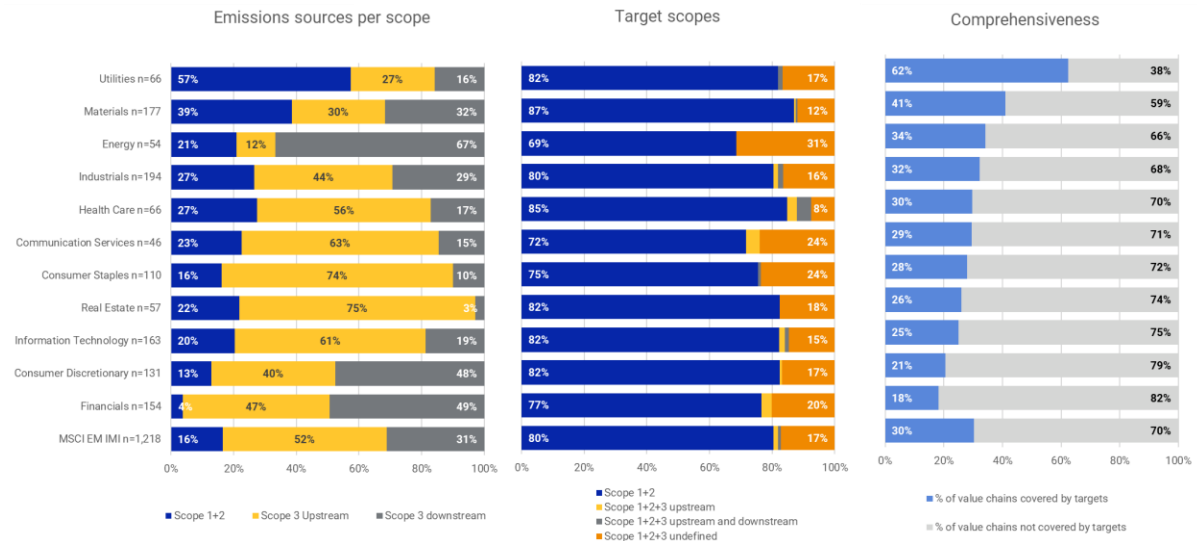
**Exhibit 6: GHG emissions and reduction targets of companies in different sectors across the MSCI Kokusai IMI**



Source: MSCI ESG Research, data as of June 30, 2023. Refers to constituents of the MSCI Kokusai IMI.

Notes: Chart on the left-hand side indicates average percentages of emissions from Scope 1+2 boundaries, Scope 3 upstream boundaries and Scope 3 downstream boundaries. The center chart indicates percentages of companies that aim to reduce Scope 1 and 2 emission, Scope 1, 2 and 3 upstream emissions, Scope 1, 2 and 3 upstream and downstream emission and Scope 1 and 2 and undefined categories of Scope 3 emissions in the final target year. Chart on the right-hand side indicates average percentages of total emissions covered by targets in each GICS sector.

**Exhibit 7: GHG emissions and reduction targets of companies in different sectors across the MSCI EM IMI**



Source: MSCI ESG Research, data as of June 30, 2023. Refers to constituents of the MSCI EM IMI.

*Notes: Chart on the left-hand side indicates average percentages of emissions from Scope 1+2 boundaries, Scope 3 upstream boundaries and Scope 3 downstream boundaries. The center chart indicates percentages of companies that aim to reduce Scope 1 and 2 emission, Scope 1, 2 and 3 upstream emissions, Scope 1, 2 and 3 upstream and downstream emission and Scope 1 and 2 and undefined categories of Scope 3 emissions in the final target year. Chart on the right-hand side indicates average percentages of total emissions covered by targets in each GICS sector.*

Meanwhile, upstream and downstream supply chain emissions constitute by far the largest portion of the carbon footprint across all four indexes. As operational and market risks associated with Scope 3 emissions start impacting businesses, for example, through reduced demands for carbon-intensive products and services, we may see more Scope 3 emissions targets emerging.

Companies that set Scope 3 targets may demonstrate a broader climate risk awareness and strategy than peers that do not, potentially indicating greater preparedness to manage transitional risks tied to their products and supply chains.

Our analysis of the MSCI target-level data showed that the comprehensiveness or emissions coverage rate of companies' climate targets depends greatly on the status of their Scope 3 target setting. As more progress is made in Scope 3 emissions disclosures and target-setting, we may see greater alignment between the emissions scopes covered by targets and the boundaries of companies' GHG emissions.

## Modelling target-based emissions projections using a Target Summary Model

### Understanding the MSCI Target Summary Model

Climate targets are a key component of the TCFD recommendations, used by companies and investors to assess and manage relevant climate-related risks.<sup>20</sup> They may continue to be a core building block within corporate climate change strategies, with an increasing number of companies setting some type of targets aiming for a target year of 2023 and later (e.g., 48% of the MSCI ACWI Index constituents had some type of target, as of June 2023, vs. 6% in 2015).

Using the MSCI Target Summary Model, MSCI ESG Research has aimed to standardize the assessment of corporate climate targets and provided an estimate of each company's target-based projected emissions. However, company climate targets can be varied, divergent and complex. Modelling the future emissions of companies based on their climate targets requires corporate disclosures that specify several factors, including targeted emissions by scope, target type (e.g., absolute or intensity-based) and the timeline of emissions reduction.

The Target Summary Model projects companies' future emissions only when companies have disclosed targets to this level of detail. In the absence of a climate target with sufficient detail, MSCI ESG Research assumes a default emissions increase of 1% per year.

Sufficiently granular target-level data can thus be a key input when modelling the emissions trajectories of companies. In this section, we summarized seven types of data points that are required for emissions projections and progress of emissions reduction under the Target Summary Model. These target-level data points are relevant not only in modelling emissions projections, but they can also be key discussion points in issuer engagement efforts. The data points are as follows:

1. **Target type (e.g., absolute or intensity target. If intensity, intensity type)**
2. **Targeted scopes and categories**
3. **Emissions reduction percentages**
4. **Base year and base year emissions**
5. **Targeted year and targeted year emissions**
6. **Reported year and reported year emissions**
7. **Coverage ratios of targeted scopes and categories**

Appendix I gives examples of data from a hypothetical company to illustrate how the Target Summary Model standardized a company's target-level data and projected its future emissions.

Companies' target disclosures often lack specific information regarding a target's baseline year, baseline value for calculating GHG emissions reductions, target coverage, targeted reduction, as well as targeted year and expected emissions at the target year. These are regarded critical information, without which MSCI ESG Research cannot project a company's emissions into the future.

<sup>20</sup> "Breaking down corporate net-zero targets." MSCI ESG Research, May 2020.

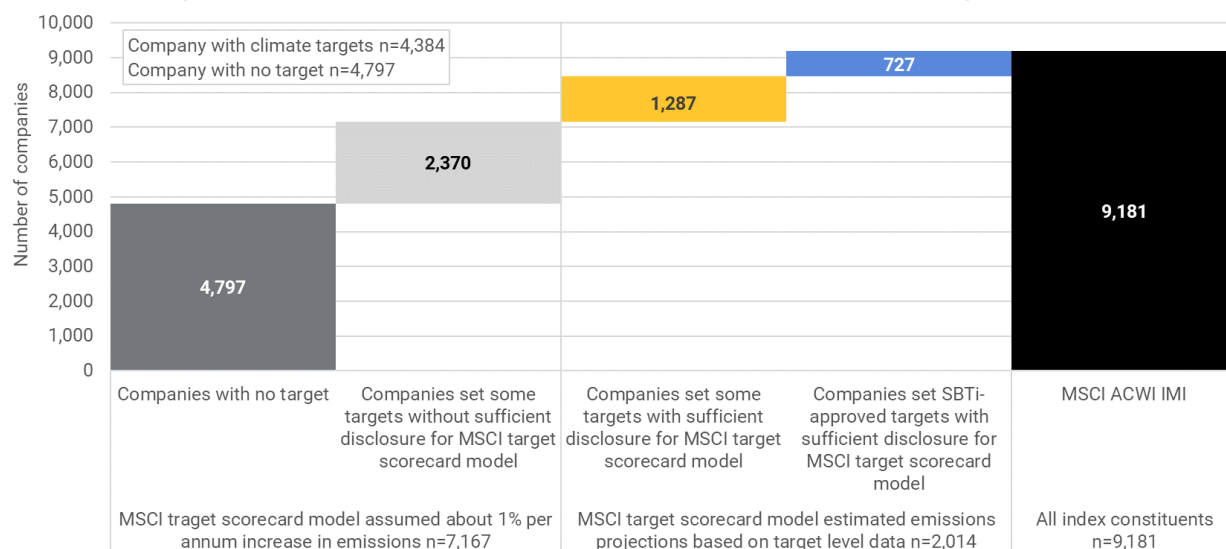
For certain cases, however, where the target description includes some critical information but is missing one partial element, MSCI ESG Research can use previously reported emissions data or minimal calculations to complete the target description and process the target into a company's future emissions projection.

By applying the imputations shown in Appendix I, MSCI ESG Research can process more companies' targets into projected emissions and may provide a more accurate view of a company's decarbonization efforts. Of the 9,181 MSCI ACWI IMI constituents, 4,384 companies set ongoing climate targets for target years of 2023 and beyond, as of June 2023.

Of the 4,384 companies with climate targets, 2,014 companies disclosed sufficient data for the MSCI Target Summary Model to estimate their emissions projections and 2,370 companies set climate targets, but they did not report sufficient data for the projection. Of the 2,014 companies that disclosed sufficient target-level data, 727 companies set SBTi-approved targets and 1,287 companies set targets that are not approved by the SBTi standard.

To see if aiming for this type of global standard might strengthen the likelihood for companies to achieve their targets, we compared the differences between the targets of companies that had committed to the SBTi standards (SBTi Group), and those that had not done so (Non-SBTi Group) in the following analysis.

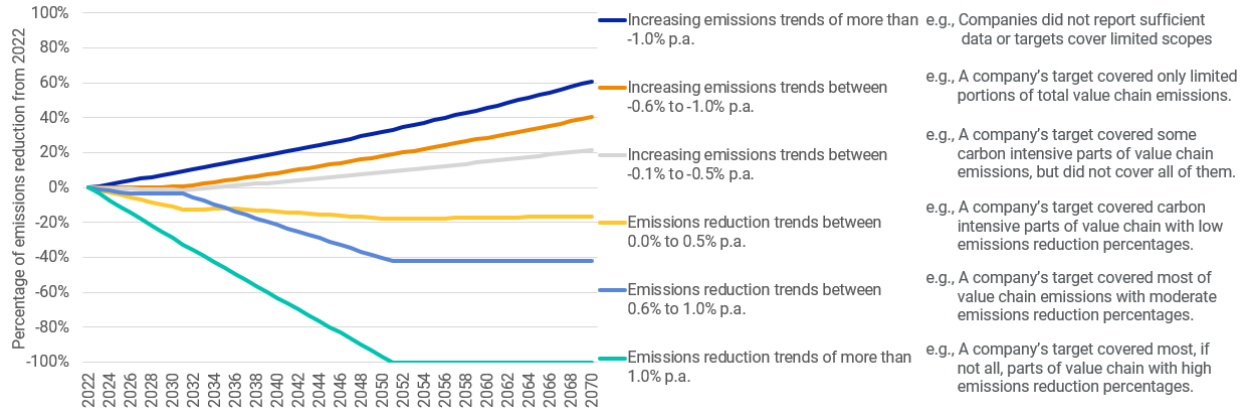
**Exhibit 8: Target variability of MSCI ACWI IMI constituents under the Target Summary Model**



Source: MSCI ESG Research, June 30, 2023. Refers to constituents of the MSCI ACWI IMI.

The Target Summary Model estimates about 1% p.a. emissions growth for companies that did not set climate targets or did not report sufficient granularity in target-level data. The Target Summary Model also estimates 1% p.a. emissions growth from scope or category of GHG emissions not covered by a company's climate targets. The chart below illustrates the classification of emission projections into six different trends.

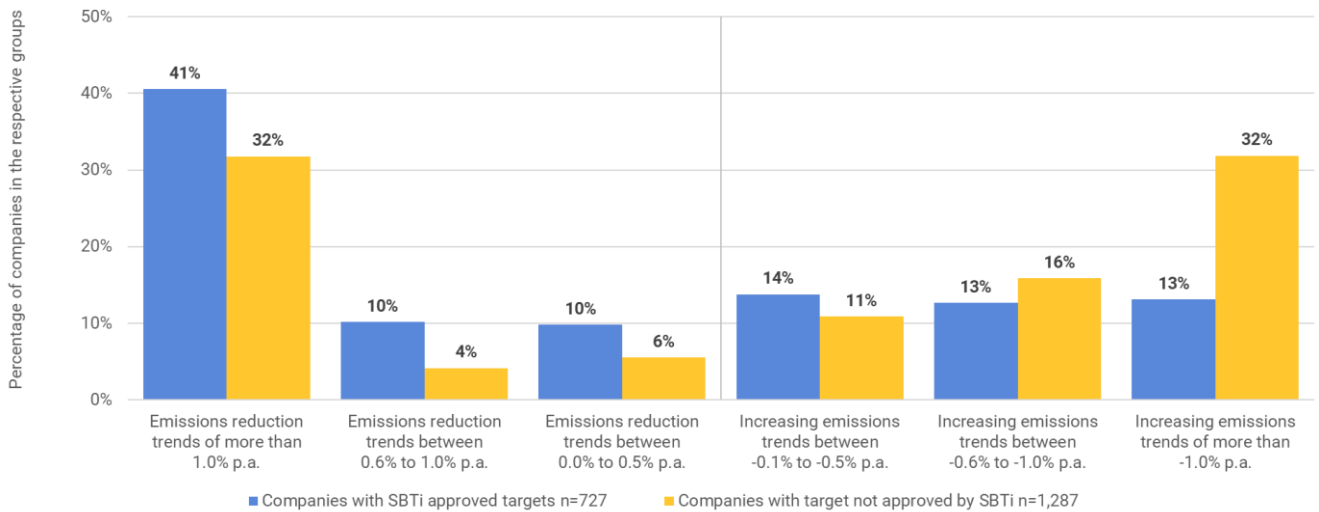
**Exhibit 9: Examples of target-based emission projections under the Target Summary Model**



Source: MSCI ESG Research

The Target Summary Model imputes high emissions reduction percentages when companies set net-zero emissions reduction targets. This imputation model resulted in high percentages of companies in both SBTi and Non-SBTi groups (i.e., 41% and 32%) that showed high emissions reduction trends. All in all, higher proportions of companies in the SBTi Group showed decreasing emissions trends than companies in the non-SBTi Group under the MSCI Target Summary Model (i.e., 61% and 42%).

**Exhibit 10: Examples of target-based emission projections for SBTi and Non-SBTi groups in the MSCI ACWI IMI**



Source: MSCI ESG Research, June 30, 2023. Refers to constituents of the MSCI ACWI IMI.

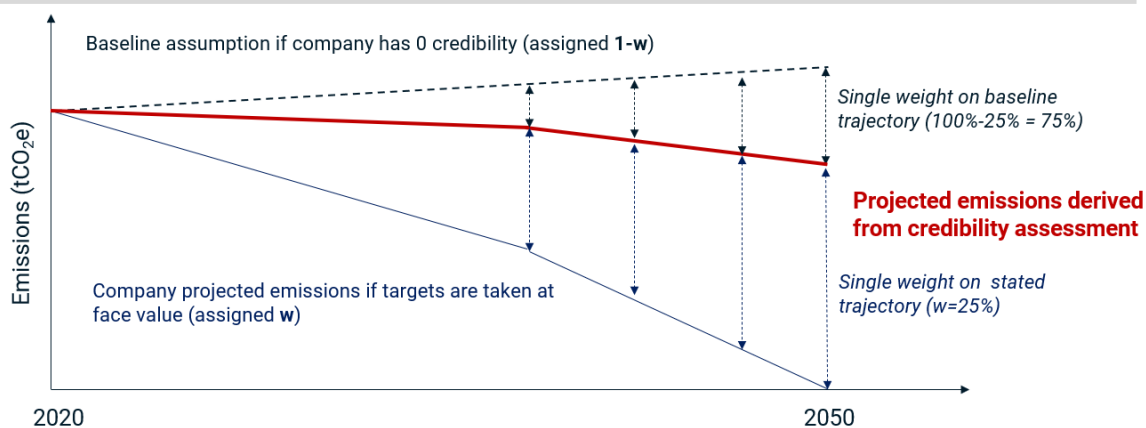
## Target-based emissions projections using target credibility assessments

At the COP 27 climate conference in Egypt, the United Nations' High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities (Expert Group) underscored the need for action on corporate climate pledges, calling for companies and financial institutions to back up their climate commitments with action and investment.

Using MSCI's Climate Change Metrics, we have outlined a climate change target assessment framework to determine what steps companies have taken to achieve their corporate climate targets. This assessment covers several key indicators recommended by GFANZ. We determine a credibility weight based on the target assessment and allocate the weight to each scope's projected emissions. The greater the credibility of a company's target, the closer we project their emissions to that target. For instance, the weight allocated in the example below is 25% (out of a maximum of 100%).

### Exhibit 11: Examples of projected company emissions based on target credibility assessments

*Projected company emissions =  $w$  \* Projected emissions based on company targets +  $(1 - w)$  \* Projected emissions according to the baseline.*



Source: MSCI ESG Research

Referring to the GFANZ recommendations, we apply the following credibility assessment formula. We apply it for each GHG scope projected emissions, using a total credibility weight.

We use a mix of forward- and backward-looking indicators that result in a score between 0% and 100% (e.g., 25% credibility on Scope 1 projections). For each scope, the maximum credibility weight is 100%. SBTi defined near-term targets, for instance, as emissions reduction targets for the next 5 to 10 years.

The SBTi at the time of this research no longer validates targets for oil & gas companies, so we redistribute a specific weighting to the oil & gas companies.

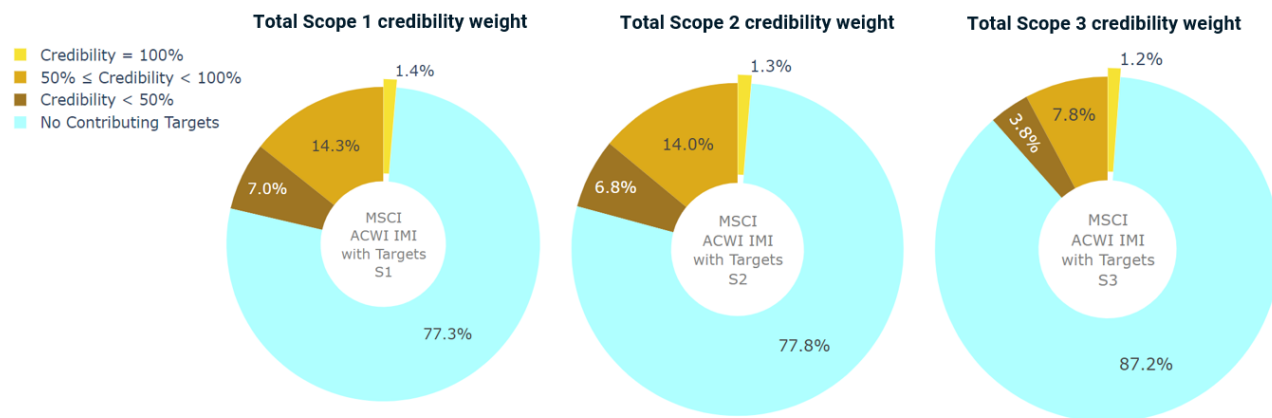
Within eligible companies in the MSCI ACWI IMI (approximately 2,000 companies), only a minority manage to get a full credibility weight of 100% for a given scope.

**Exhibit 12: Examples of target credibility assessment metrics**

Question	Factor	Scope specific?	Weight w (adds up to 100%)
Does the company have any short-term targets?	Target year	Scope-specific weighting	40% for having at least one target set between 2020 and 2030 20% for having only target(s) beyond 2030
Does the company have third party verified targets?	SBTi approved target(s)	Company-wide weighting	Yes = 20% No = 0%  *Not applicable for oil & gas companies
Does the company have a good track record of achieving targets in the past?	Record on achieving targets		% of past targets achieved * 20%  *For oil & gas companies, % of past targets achieved * 30%
Is the company currently achieving targets?	Being (linearly) on track to achieve targets		On track for at least some targets = 20% Not on track to meet any targets = 0%  *For oil & gas companies, On track for at least some targets = 30%

Source: MSCI ESG Research

**Exhibit 13: Results of target credibility assessments per target scope**



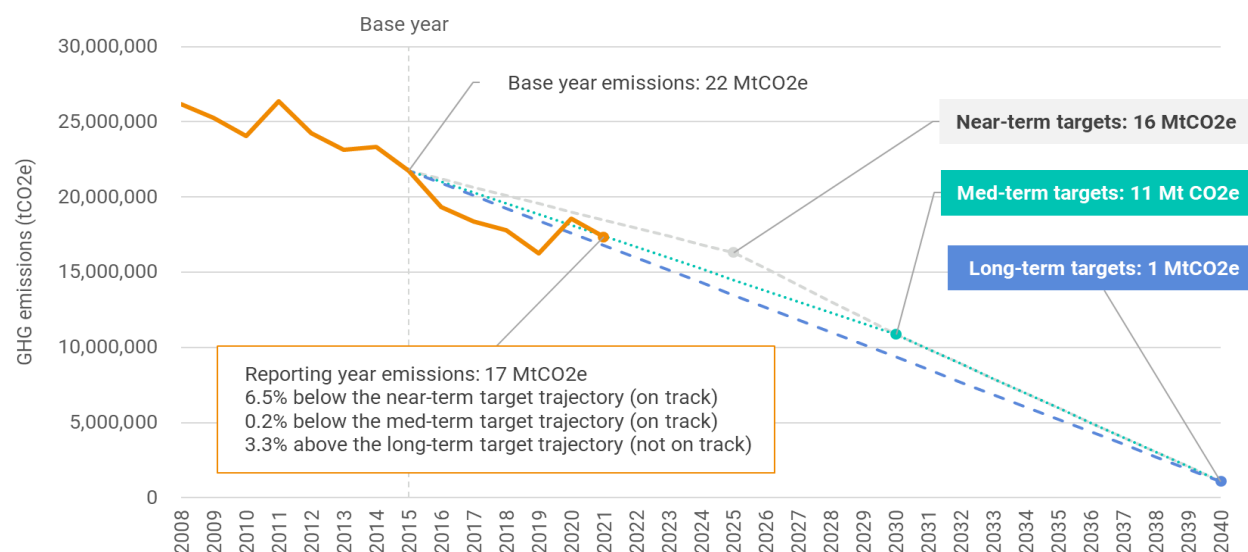
Source: MSCI ESG Research. Data as of April 2023



How successfully a company has been in reducing its emissions relative to its ongoing targets may also add useful context. Specifically, taking historical emissions performance and benchmarking it against a company's targeted trajectory can offer a helpful sense check. In this track record analysis, we drew a linear target trajectory, linking base year emissions to target year emissions.

By comparing a company's reporting year emissions with its target trajectory, we assume that companies are on track to meet their climate targets if their reporting year emissions are below its target trajectory in the reporting year. By contrast, the steeper a company's target trajectory relative to its base year emissions trend, the more drastic its future mitigation efforts will need to be to meet its targets (Exhibit 14).

**Exhibit 14: Examples of track record analysis for ongoing targets**



Source: MSCI ESG Research. Based on a hypothetical company. Notes: SBTi was developing a guide on what companies are required to report for target progress at the time of this research. The SBTi aims to complete the development of the SBTi progress framework by COP28. Please see SBTi. "Measurement, Reporting and Verification (MRV)." Last accessed as of March 1, 2023.

Using these target credibility assessment metrics, we have compared the target credibility weights for constituents of the MSCI ACWI IMI that had set SBTi-approved targets (SBTi group) and those that had set targets that are not approved by the SBTi standard. (non-SBTi group).

We found that **about 95% of companies in the SBTi Group had a 40% credibility assessment for their Scope 1+2 targets, compared to about 80% for companies in the Non-SBTi Group.**<sup>21</sup> The difference between the SBTi and Non-SBTi Groups was more apparent in their Scope 3 target credibility assessments. **About 71% of companies in the SBTi Group had a 40% credibility assessment for their Scope 3 targets, compared to only 24% of companies in the Non-SBTi Group.**

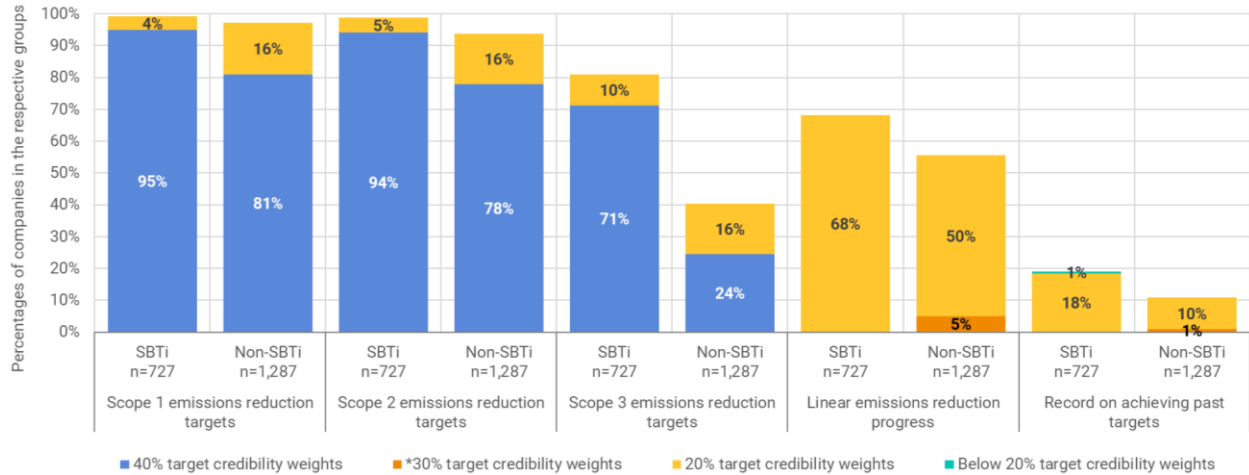
Further we found that about 70% of companies in the SBTi Group made emissions reduction progress at least for one of targets, compared to 55% of companies in the Non-SBTi Group.

Overall, companies in the SBTi Group have had higher credibility weights in achieving their targets than ones in Non-SBTi Group. This may suggest that companies that went through a rigorous third-

<sup>21</sup> 40% is full credibility weight for target year (please see Exhibit 12).

party target-validation process under the SBTi standards were more likely to have disclosed target-level data, increased the transparency of their emissions-reduction strategies, and made further progress on emissions reduction activities.

**Exhibit 15: Examples of target credibility assessments for SBTi and Non-SBTi groups of MSCI ACWI IMI constituents**



Source: MSCI ESG Research, June 30, 2023

Achieving climate targets remains a more demanding prospect than in setting them. However, the results of these assessments highlighted how rigorous third-party validation processes, like those under SBTi, could offer scope to enhance the transparency of corporate decarbonization strategies and to improve the likelihood that the companies can achieve such climate targets.<sup>22</sup>

<sup>22</sup> "Assessing Science-Based Corporate Climate Target-Setting." MSCI ESG Research. June 2023.

## Impact analysis using Implied Temperature Rise (ITR)

MSCI's Implied Temperature Rise (ITR) computes the forward-looking temperature alignment of companies, portfolios and funds with global temperature goals. ITR is designed to help investors evaluate how companies and portfolios manage their "fair share" of decarbonization efforts to limit global warming.

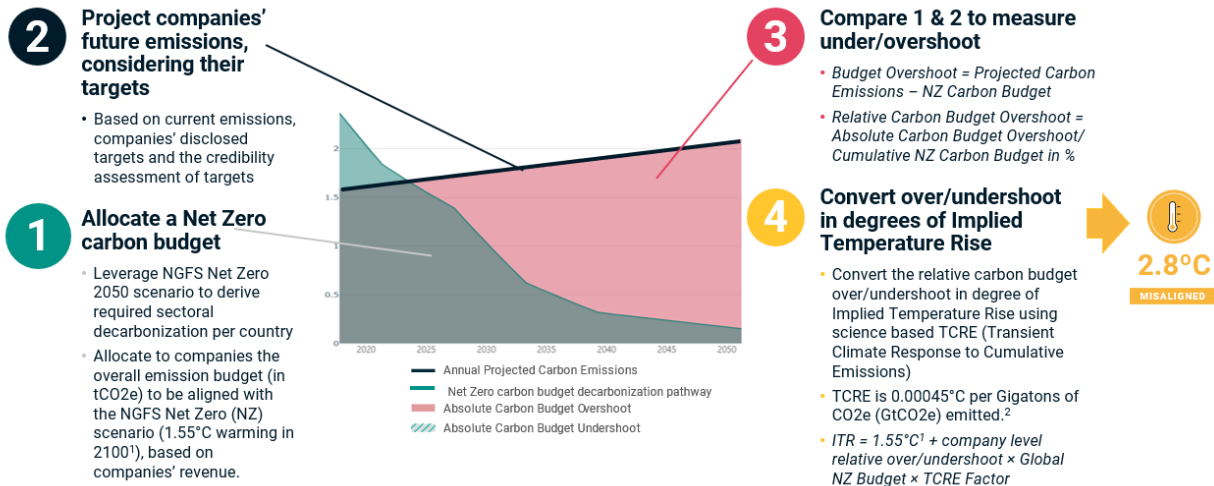
To do so, ITR allocates a carbon budget to companies, which can be aggregated at portfolio level. The model then extrapolates this value to estimate planetary warming to a 2100 horizon if the global economy had the same carbon budget overshoot or undershoot as a given company or portfolio. For instance, 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 ITR model, which helps investors set portfolio temperature objectives and engage with companies.

ITR is also designed to provide information on the alignment of financial activities with a well-below 2°C scenario, as recommended by the Task Force on Climate-related Financial Disclosures.<sup>23</sup> This is the key focus of this report.

See full methodology guide on [www.msci.com/our-solutions/climate-investing/implied-temperature-rise](http://www.msci.com/our-solutions/climate-investing/implied-temperature-rise).

### Exhibit 16: Model steps overview for Implied Temperature Rise

## Measure Temperature Alignment: Model Steps Overview



1) 1.55°C is the baseline temperature of the REMIND Net Zero 2050 NGFS scenario. Any overshoots/undershoots of the benchmark are relative to this 1.55°C baseline.  
 2) IPCC AR6 Report (Summary for Policymakers): "Each 1000 GtCO<sub>2</sub> of cumulative CO<sub>2</sub> emissions is assessed to likely cause a 0.27°C to 0.63°C increase in global surface temperature with a best estimate of 0.45°C"

Source: MSCI ESG Research

<sup>23</sup> "Guidance on Metrics, Targets, and Transition Plans." Task Force on Climate-related Disclosures (TCFD), October 2021.

In 2023 MSCI ESG Research implemented a series of updates to the ITR methodology based on the latest best practice guidance for measuring portfolio alignment published by the Glasgow Financial Alliance for Net Zero (GFANZ).<sup>24</sup> The updated methodology:

- Features sector-specific pathways for limiting warming to 1.5°C.** The metric now aligns with open source 1.5°C decarbonization pathways provided by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) and developed by climate scientists.<sup>25</sup> (It previously aligned with 2°C pathways based on high-level assumptions from the U.N. Intergovernmental Panel on Climate Change.) The change also aligns the metric fully with GFANZ's recommendation that portfolio alignment metrics should reflect differences in decarbonization pathways for specific sectors and regions. A company's pathway in the Indian cement sector, for example, now reflects the sector's ability to transition to net-zero based on scientific assumptions.
- Brings forward to 2050 the time horizon for reaching net-zero.** MSCI ESG Research assumes that the world can reach net-zero by midcentury, based on the NGFS REMIND Net Zero 2050 scenario. The metric previously assessed companies' decarbonization based on a scenario where the world reached net-zero emissions by 2070, in line with a 2°C pathway.
- Weighs the credibility of corporate decarbonization targets.** We now adjust projected company emissions for credibility instead of taking any climate target at face value. To define a credibility weight, we assess whether a company has at least one short-term target for each emissions scope, at least one target validated by the Science-Based Targets initiative (SBTi), a record of achieving past targets, and a current trajectory to meet at least some of its future targets. Because SBTi does not currently validate decarbonization targets for oil and gas companies, we consider whether such companies are on track to meet at least some of their targets.<sup>26</sup>
- Fine tunes the calculation of companies' remaining carbon budgets.** Our latest methodology allocates a carbon budget to each company starting Jan. 1, 2020 and ending in 2050, based on the company's 2019 revenue and NGFS revenue-intensity pathways.<sup>27</sup> Rather than recalculate the budget based on new annual revenue data as our methodology directed previously, we now update what remains of the company's initial emissions budget based on whether the company gained or lost market share during the previous year. A company's economic performance can only influence the budget if it increases or decreases the company's market share. This ensures company carbon budgets are redistributed within a sector, consistent with the reality of a limited global budget.<sup>28</sup> In addition, we subtract from each company's remaining carbon budget the reported and estimated quantity of greenhouse gases emitted by the company in the prior year. Realized company emissions now count towards decreasing carbon budgets.

<sup>24</sup> "Measuring Portfolio Alignment: Driving Enhancement, Convergence, and Adoption." GFANZ, November 2022.

<sup>25</sup> "NGFS Climate Scenarios for central banks and supervisors." NGFS, Sept. 6, 2022.

<sup>26</sup> "Oil and Gas: Next Steps for the SBTi's Guidance Development." SBTi, Jan. 12, 2023.

<sup>27</sup> Revenue intensity refers to the amount of carbon a company emits to generate every USD 1 million of revenue. See "Understanding MSCI's Climate Metrics," MSCI ESG Research, January 2023.

<sup>28</sup> Market share reflects a company's revenue as a proportion of global revenue for its main MSCI emissions sector.

Because of this switch from the current ITR model to the updated model for this 2023 portfolio analysis, we note that comparison with ITR data previously reported by GPIF has some limits. In addition, the updated ITR model outputs used in this report are simulated results.<sup>29</sup>

This report section analyzes the following elements:

- Changes in ITR output at the GPIF total portfolio as of March 31, 2022 (FY2021), using the current model vs the updated model.<sup>30</sup>
- Change in the GPIF total portfolio ITRs from FY2021 to FY2022 (as of March 31, 2023), using the updated model.
- Asset class level ITRs within the total GPIF portfolio as of FY2022.
- GICS sector level ITRs for each four-asset class (Yen Equity, Non-Yen Equity, Yen Fixed Income, and Non-Yen Fixed Income) in the FY 2022 GPIF portfolio, using the updated model.

**Exhibit 17: Difference between current ITR model (green bars on the left) and updated ITR model (blue bars on the right) per asset class for FY2021 GPIF portfolio**



Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

The chart above shows that, aside from the Yen Equity portfolio, the model changes do not significantly impact broad asset class or regional aggregated outputs, even though individual sectors or issuers may be more significantly impacted.

Similarly, when applying the updated ITR model to the total GPIF portfolios (Yen, non-Yen, both equities and Fixed Income) retroactively over the last two years between FY2021 and FY2022, the output remains stable at 2.5°C. A broad portfolio is influenced by the state of the economy – which is currently not on track to meet the objectives of the Paris agreement. While the GPIF portfolio appears “misaligned” with global climate goals, a portfolio ITR is best understood in relative terms.

<sup>29</sup> Please note that updated ITR results were based on simulated results as of April 2023. The results using the published data may differ from the simulated results.

<sup>30</sup> Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023.

The GPIF portfolio is in fact more aligned than the MSCI ACWI IMI which displays an ITR of 2.6°C.<sup>31</sup> This shows that while the GPIF portfolio is “misaligned”, it performs slightly better than the broad investment universe in which GPIF operates. However, when focusing on Yen Equities, we find that the GPIF Yen Equities portfolio (2.5°C) is slightly less aligned than its local benchmark (Japan Equities: 2.4°C in updated ITR model).<sup>32</sup>

**Exhibit 18: GPIF portfolio-level ITR in FY2021 and FY2022**

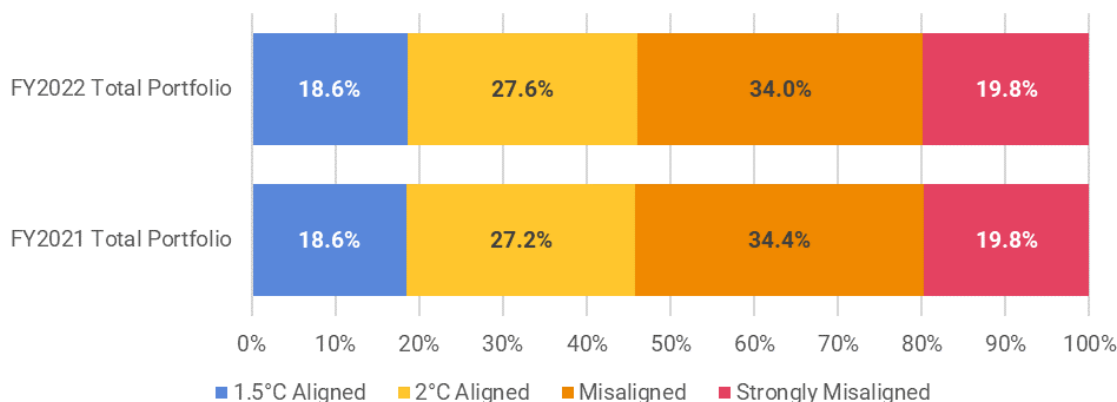


Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

However, the proportion of 2°C-aligned companies in the portfolio increased slightly from 27.2% in FY2021 to 27.6% in FY2022.

**Exhibit 19: Distribution of company ITR Bands in the GPIF total portfolios in FY2021 and FY2022**



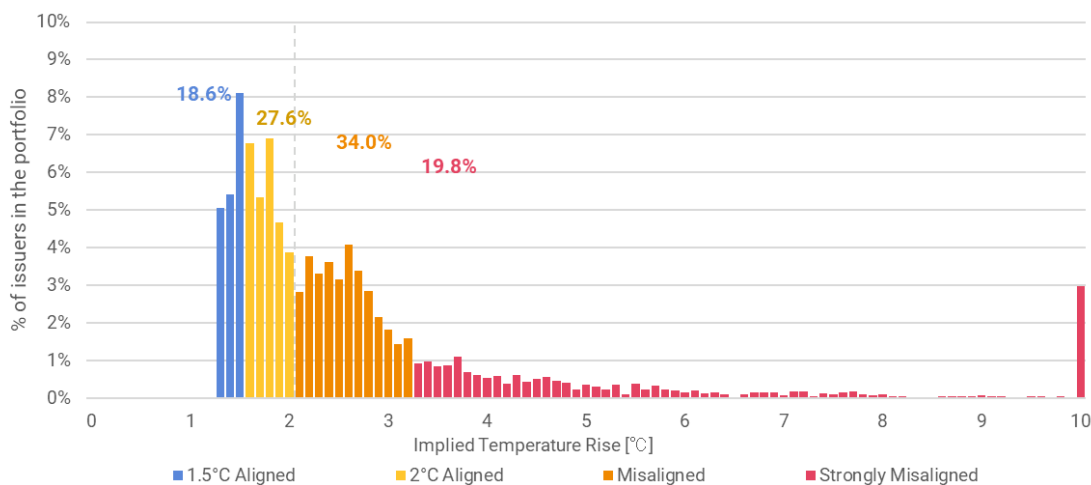
<sup>31</sup> Based on simulated results as of July 6, 2023.

<sup>32</sup> Based on simulated results for the MSCI Japan Index as of July 6, 2023.

Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

**Exhibit 20: Distribution of issuers per updated ITR status in the GPIF total portfolios in FY 2022**

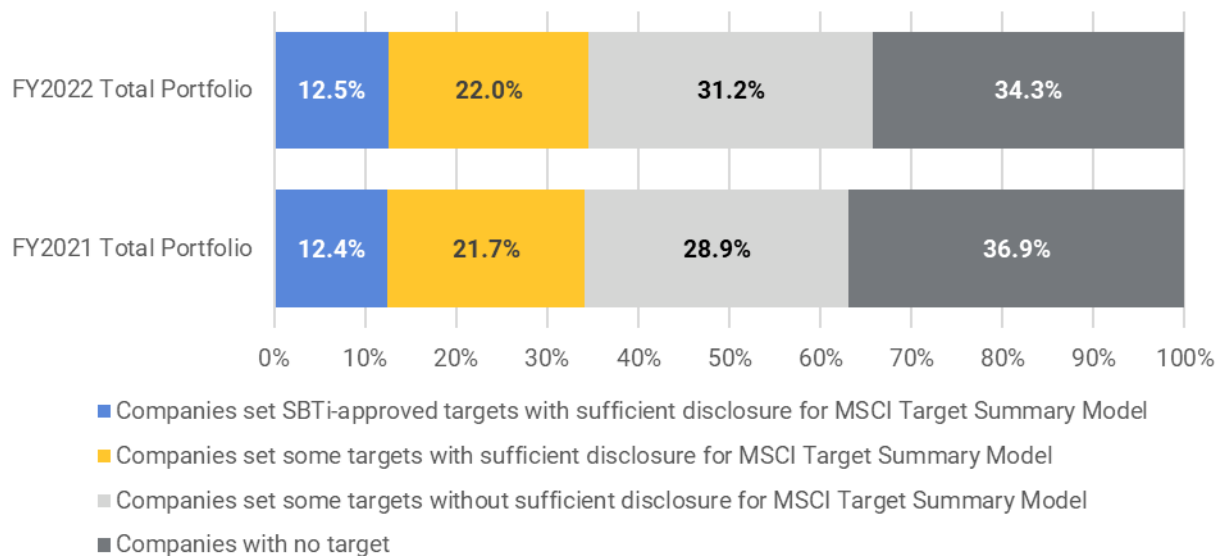


Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

Climate targets are a key input for the ITR model, which can also be analyzed on a standalone basis. The companies that have set no target has decreased from 36.9% in FY2021 to 34.3% in FY2022. The proportion of the companies with sufficient target-level data disclosure (covering data points that we assess under the MSCI Target Summary Model) has also increased to 34.5% (i.e., 12.5% of companies with SBTi-approved targets and 22.0% with some targets) in FY2022 from 34.1% (i.e., 12.4% of companies with SBTi-approved targets and 21.7% with some targets) in FY2021. The share of issuers with targets approved by the Science-Based Targets Initiative (SBTi) remained almost the same at 12.4% in FY2021 and 12.5% in FY2022.

**Exhibit 21: Changes in the proportions of issuers with SBTi-approved targets, clear climate targets and no clear target in the GPIF total portfolios in FY2021 and FY2022**



Source: MSCI ESG Research, April 1, 2023

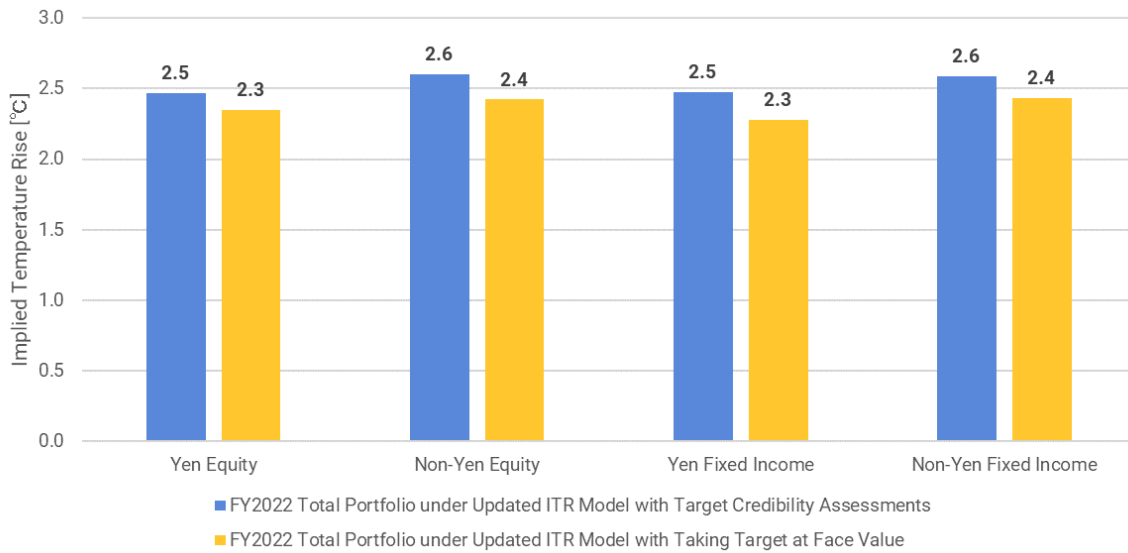
Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023.

By contrast with the current ITR model, the updated ITR model does not take corporate climate targets at face value (i.e., assuming they will be fully followed through and achieved). Instead, using guidance from the GFANZ Portfolio Alignment recommendations, MSCI ESG Research has developed a target credibility assessment whereby the influence of climate targets on projected emissions is moderated to some extent by a credibility weighting.

The assessment applies to all three GHG emissions scopes. It takes into account the existence of short-term targets, third party verification (typically undertaken by SBTi), the issuer’s track record for achieving past targets, and progress towards current targets. The details of these weighting indicators are described in a methodology note (accessible [here](#)). As illustrated in the following diagram, since some targets are discounted, the updated ITR model produces “hotter” values across GPIF’s invested asset classes when compared to the same model without the target credibility assessment feature.



**Exhibit 22: Comparative analysis of ITR values in the GPIF FY2022 portfolio when taking targets at face value, versus including a target credibility component**

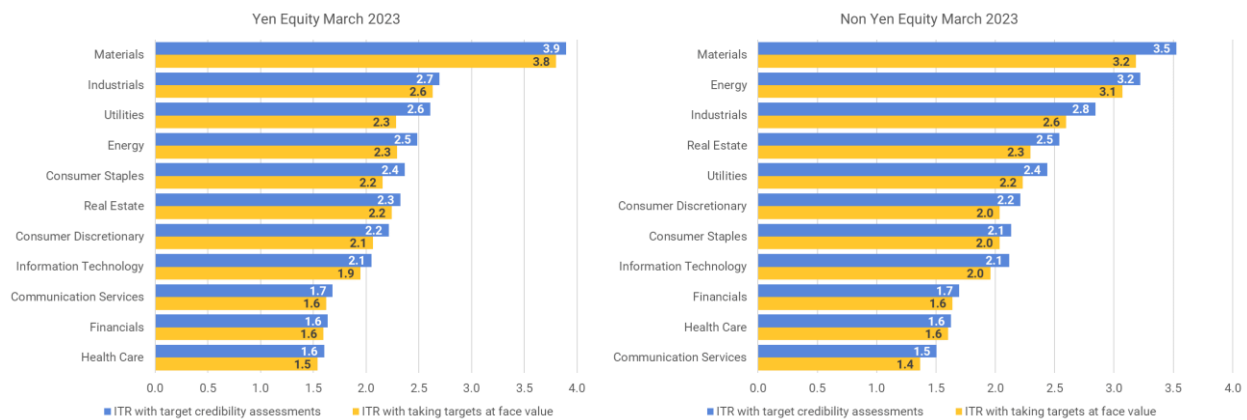


Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

We performed this comparative analysis of ITR based on targets at face value vs. ITR based on credible targets across GICS sectors, both for GPIF’s Yen and non-Yen equity portfolios in FY2022. Both the Yen and non-Yen portfolios showed systematically lower ITR values when targets are taken at face value, in every sector. Sectors such as materials, energy, industrials and utilities showed higher discrepancy and/or higher ITR values. This may reflect greater gaps between target ambition and measurable emissions reduction progress towards those targets. We saw similar results when doing the same analysis on Yen and non-Yen fixed income portfolios.

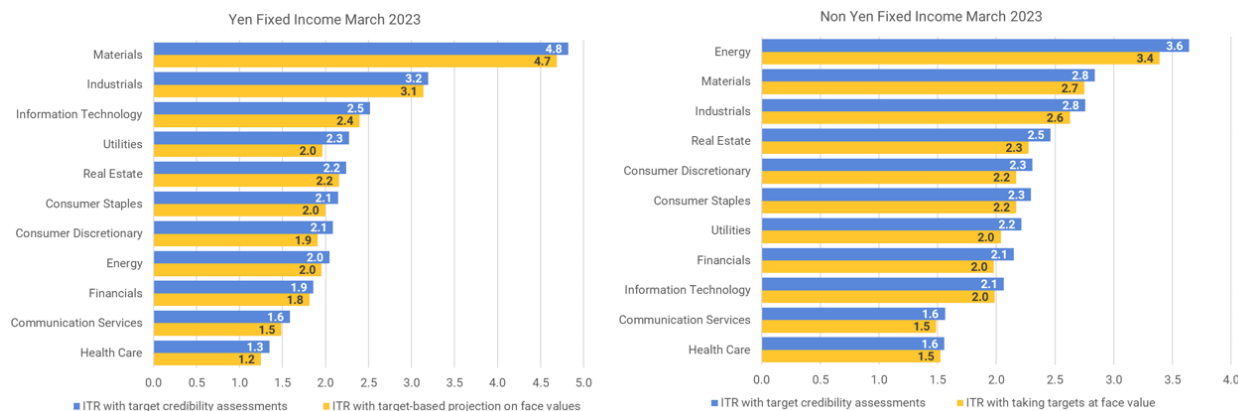
**Exhibit 23: Comparative analysis of ITR values for Yen and Non-yen Equities in the GPIF FY2022 portfolio when taking targets at face value, versus including a target credibility component**



Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

**Exhibit 24: Comparative analysis of ITR values for Yen and Non-yen fixed income investments in the GPIF FY2022 portfolio when taking targets at face value, versus including a target credibility component**



Source: MSCI ESG Research, April 1, 2023

Notes: Unless otherwise noted, updated ITR results in this report were based on simulated results as of April 2023

In conclusion:

- Applying the updated ITR model, the proportion of Paris-aligned companies, especially aligned with 2.0°C, has slightly increased in the GPIF portfolios between FY2021 and FY2022. This also reflects the fact that more MSCI ACWI IMI companies have strengthened their net-zero ambitions in recent times.
- GPIF’s total portfolio-level ITR remains stable between FY2021 and FY2022, using the updated ITR model. At 2.5°C, it remains misaligned with the goals of the Paris Agreement. It is however performing slightly better than a benchmark (MSCI ACWI IMI: 2.6°C), which illustrates the scale of the challenge to meet the Paris Agreement targets. This non-significant difference can be explained by the fact that a large part of GPIF’s total portfolio is passively managed.
- The proportion of companies with climate targets, including SBTi-approved targets, has also increased during the same period. This is a positive change towards a “cooler” portfolio ITR.
- When taking corporate targets at face value, the GPIF ITR values would decline by 0.2°C. However, the target credibility assessment feature makes ITR values hotter by increasing company projected emissions, particularly in certain sectors.

## Climate-related risks for the sovereign bond portfolio

### MSCI Sovereign Bond Climate Value-at-Risk

We conducted an analysis on the potential impact of climate change and economic decarbonization on sovereign bonds using the MSCI Sovereign Bond Climate Value-at-Risk (VaR).<sup>33</sup> 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 scenario. We use the framework put forward by the Network for Greening the Financial System (NGFS) and their scenarios for interest rates under various climate change scenarios.

Based on the NGFS scenarios, we derived potential shocks to sovereign bond yield curves, and, using our stress testing capabilities, we used these shocks to reprice sovereign bonds in our Sovereign Bond Climate VaR model. These scenarios predominantly focus on transition risks and incorporate to some extent the impact of chronic physical risks,<sup>34</sup> but acute physical risks are not yet part of the macroeconomic modeling in the NGFS scenarios.

The below illustrates the workflow:

- The scenarios are based 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 as well as a climate-agnostic baseline scenario.
- We then estimate how today's yield curve would look if markets priced a given scenario and its interest rate projections.
- The difference between the implied yield curve from a climate scenario and the baseline scenario gives us the 'shock' we would observe if markets changed expectations from the climate-agnostic baseline to a particular climate scenario.
- This yield curve shock is then the input into a stress test which reprices a universe of sovereign bonds. The inflation shocks are also included in a similar way.

### NGFS scenarios

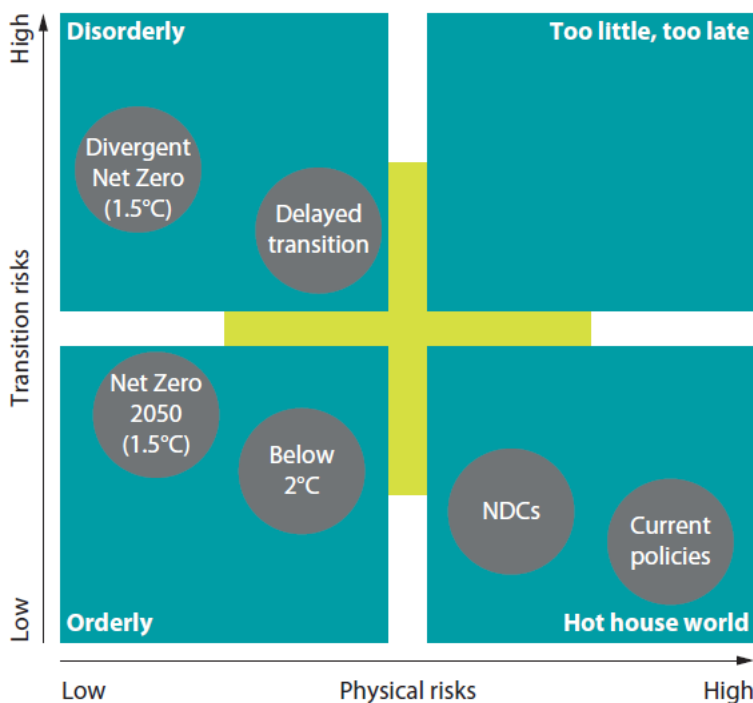
In line with the TCFD recommendations, the Network for Greening the Financial System (NGFS), a group of central banks and supervisors, implemented a set of hypothetical scenarios for climate change. They developed six scenarios with varying severity of physical risks (hot house world scenarios versus scenarios with lower physical impacts) and varying degrees of transition risks (going from an orderly transition to delayed and disorderly transitions). To conduct analysis on the GPIF portfolio, we used five scenarios except for Current Policies. In the Current Policies scenario, the impacts on inflation rate are negligible reflecting not only limited transition risk but also the fact that only one potential physical risk transmission channel (productivity) has been modelled.<sup>35</sup>

<sup>33</sup> Scenarios analysis under the MSCI Sovereign Bond Climate Value-at-Risk predominantly focus on transition risks and incorporate to some extent the impact of chronic physical risks, but acute physical risks or low carbon technology opportunities were not yet part of the macroeconomic modeling in the NGFS scenarios.

<sup>34</sup> Chronic physical risks are related to longer-term shifts in climate patterns, such as sustained higher temperatures, that may cause sea level rise or chronic heat waves.

<sup>35</sup> "NGFS Scenarios for central banks and supervisors." NGFS, September 2022.

**Exhibit 25: NGFS scenario framework**



Note: NDCs stand for Nationally Determined Contributions. Source: Network for Greening the Financial System

In September 2022, NGFS published the third climate scenario (phase III scenarios), an updated set of climate scenarios reflecting the latest trends including the new country-level commitments to reach net-zero emissions, the latest GDP and population pathways.<sup>36</sup>

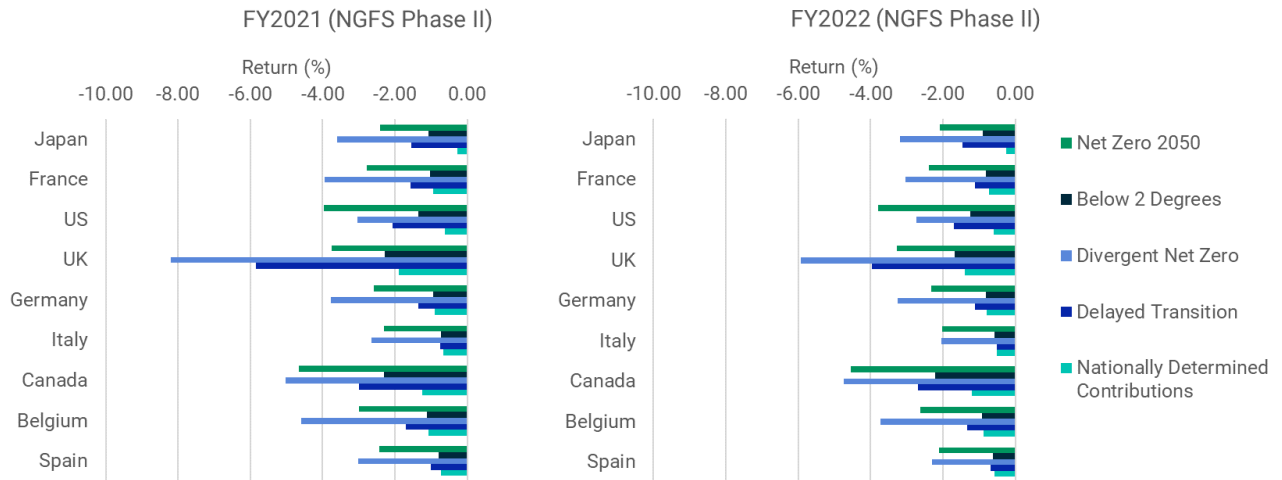
**Results for GPIF’s sovereign bonds portfolio**

We ran an analysis for GPIF’s latest portfolio as of the end of March 2023 (FY2022) using phase III scenarios.<sup>37</sup> In addition, to compare the results using the previous version of scenarios (phase II scenarios) that were included in GPIF’s report last year “GPIF 2021 ESG Report”, we also ran FY2022 portfolio using phase II scenarios and compare the results of FY2021 portfolio using phase II scenarios for countries that accounted for the highest portion of market caps (Exhibit 26). While we did not find a change in the order of results by scenario between FY2021 and FY2022 using phase II, the UK bonds incurred smaller losses especially for Divergent Net Zero scenario. This was partly because the UK bonds that were newly added in FY2022 portfolio had relatively low impacts.

<sup>36</sup> “NGFS publishes the third vintage of climate scenarios for forward looking climate risks assessment | Banque de France.” NGFS, September 6, 2022.

<sup>37</sup> Please note that the results were based on pro-forma data that we computed for GPIF as of June 2023. The results using the published data may differ from the results based on pro-forma data.

**Exhibit 26: Sovereign bond Climate VaR results by country for the GPIF portfolio using NGFS phase II scenarios (FY2021 vs. FY2022)**

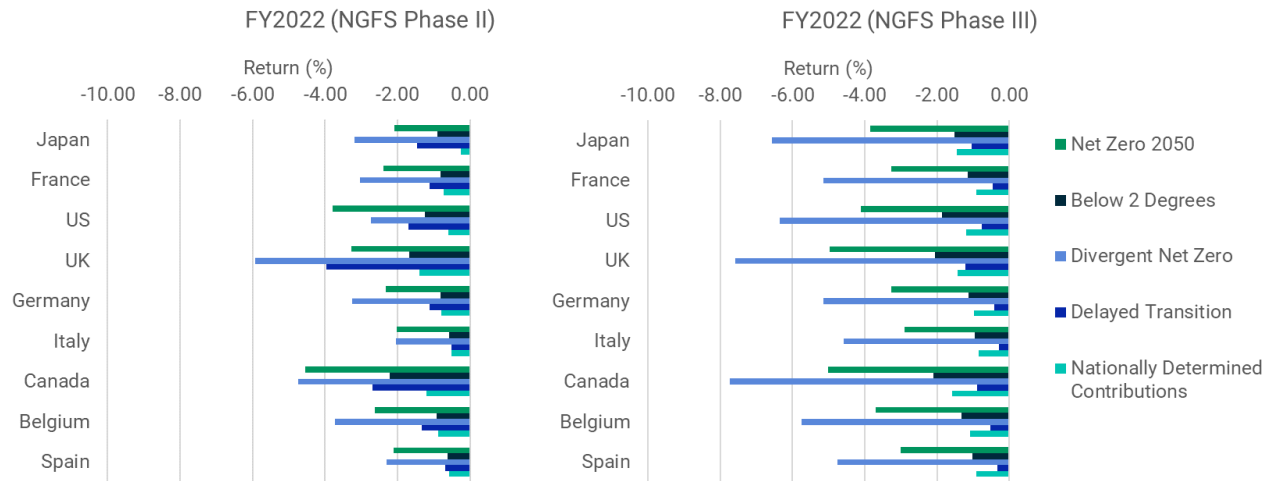


Source: MSCI ESG Research

We also compared the results for the FY2022 portfolio between NGFS phase II and phase III scenarios (Exhibit 27). We found that the losses were generally more severe under the Phase III scenarios, especially for the Divergent Net Zero scenario. **Also, notably for U.S. bonds, Divergent Net Zero scenario showed the largest negative return in phase III, whereas in phase II, Net Zero 2050 scenario showed the largest negative return for U.S. bonds.** This was partly because yield curve shocks were higher in phase III than those in phase II especially for Divergent Net Zero scenario for most year/tenor (Appendix II). NGFS assumed that in the disorderly scenarios policy uncertainty may lead to a higher investment premium, lasting for two years, with the premium gradually returning to baseline thereafter, which occurs in the period 2021-2022 in the Divergent Net Zero policies scenario and 2030-2031 in the Delayed Transition scenario.<sup>38</sup>

<sup>38</sup> "NGFS Scenarios for central banks and supervisors." NGFS, September 2022.

**Exhibit 27: Sovereign bond Climate VaR results by country for the GPIF portfolio for FY2022 (NGFS phase II scenarios vs. phase III)**

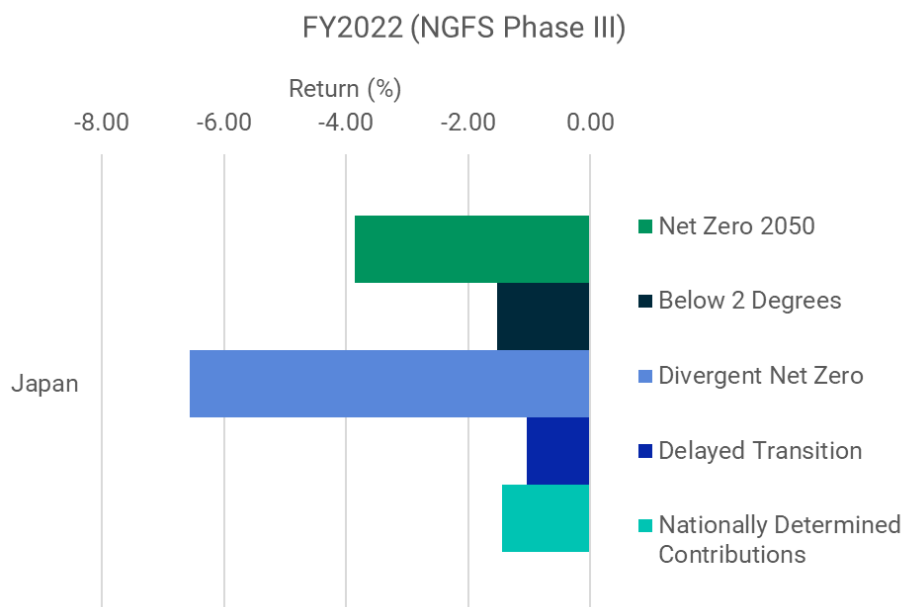


Source: MSCI ESG Research

We took a closer look at the results using phase III scenarios for Japan and U.S. sovereign bonds of FY2022 portfolio as those two countries accounted for the highest portion of holdings: Japan for about half and U.S. for about a quarter in FY2022 sovereign bonds portfolio of GPIF.

**Both Japan and the U.S. experienced the largest impacts under the Divergent Net Zero scenario** (Exhibit 28 and 30). Also, **both countries' relatively longer maturity bonds (in buckets 10-20 years and 20+ years) experienced the largest impact** (Exhibit 29 and 31). Focusing on the Divergent Net Zero Scenario, while the impacts under those relatively longer maturity bonds were higher for the U.S. than those for Japan, the portfolio weights of those bonds were higher for Japan than those for U.S., which led to similar impacts (Japan of -6.6% and U.S. of -6.4%).

**Exhibit 28: Sovereign bond Climate VaR results for Japanese bonds in the FY2022 GPIF portfolio using NGFS phase III scenarios**



Source: MSCI ESG Research

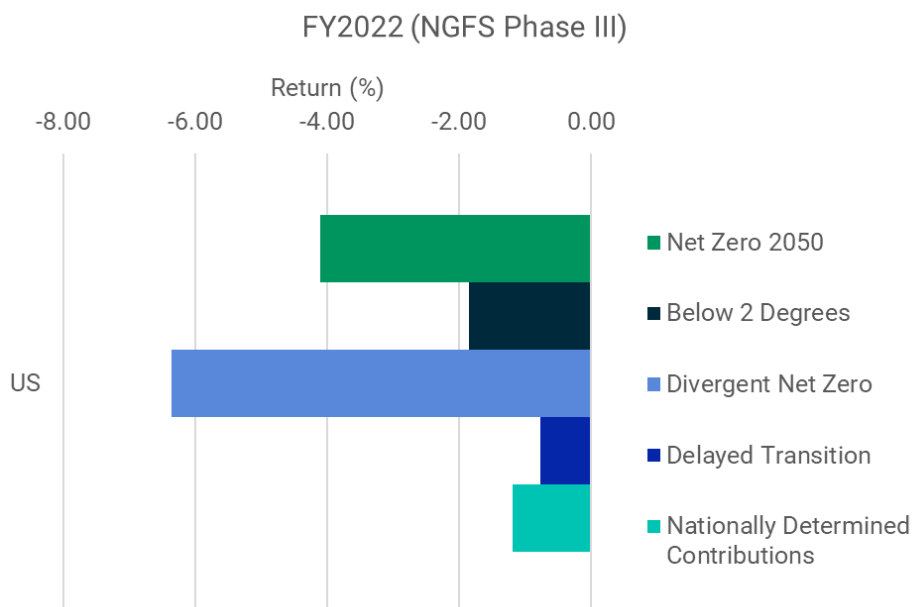
**Exhibit 29: Sovereign bond Climate VaR results for Japanese bonds in the FY2022 GPIF portfolio using NGFS phase III scenarios and across different time to maturity buckets (return %)**

Time to maturity	Weight	Net Zero 2050	Below 2 Degrees	Divergent Net Zero	Delayed Transition	Nationally Determined Contributions
1- years	2.3%	-0.2	-0.1	-0.3	0.0	-0.1
1-5 years	36.8%	-1.3	-0.4	-1.9	-0.2	-0.4
5-10 years	21.0%	-3.9	-1.3	-6.6	-0.6	-1.4
10-20 years	25.5%	-7.2	-3.0	-12.6	-1.9	-2.8
20+ years	14.5%	-5.1	-2.2	-8.8	-2.6	-1.9
<b>Total</b>	<b>100.0%</b>	<b>-3.9</b>	<b>-1.5</b>	<b>-6.6</b>	<b>-1.0</b>	<b>-1.4</b>

Note: Weight assumes that the portfolio consists of only Japanese sovereign bonds.

Source: MSCI ESG Research

**Exhibit 30: Sovereign bond Climate VaR results for U.S. bonds in the FY2022 GPIF portfolio using NGFS phase III scenarios**



Source: MSCI ESG Research

**Exhibit 31: Sovereign bond Climate VaR results for U.S. bonds in the FY2022 GPIF portfolio using NGFS phase III scenarios and across different time to maturity buckets (return %)**

Time to maturity	Weight	Net Zero 2050	Below 2 Degrees	Divergent Net Zero	Delayed Transition	Nationally Determined Contributions
1- years	1.5%	-0.1	-0.1	-0.5	0.0	-0.1
1-5 years	52.6%	-2.0	-0.9	-3.2	-0.1	-0.5
5-10 years	25.0%	-5.1	-2.2	-7.7	-0.3	-1.4
10-20 years	7.7%	-9.2	-4.3	-14.1	-2.6	-2.8
20+ years	13.3%	-8.3	-4.1	-12.7	-3.6	-2.6
<b>Total</b>	<b>100.0%</b>	<b>-4.1</b>	<b>-1.9</b>	<b>-6.4</b>	<b>-0.8</b>	<b>-1.2</b>

Note: Weight assumes that the portfolio consists of only U.S. sovereign bonds.

Source: MSCI ESG Research



## Climate-related risks on the real estate portfolio

### MSCI Real Estate Climate Value-at-Risk

Buildings are a significant source of global greenhouse gas (GHG) emissions as well as a key driver of energy consumption.<sup>39</sup> Thus buildings may play an important role in a country's decarbonization efforts. At the same time, physical risks exacerbated by climate change are increasingly affecting assets, e.g., through damages caused by rising sea levels or strong winds. Using the MSCI Real Estate Climate Value-at-Risk (VaR), we conducted an analysis of the GPIF's investments in commercial and residential real estate as of the end of March 2023 (FY2022) to evaluate the risks of both climate transition policy and physical climate-related impacts in their portfolio.<sup>40</sup>

#### The Transition Policy Risk Model

The Transition Policy Risk model assesses the potential cost impact from a transition to a low-carbon economy under different scenarios.

In the Transition Policy Risk computation, reduction requirement pathways are derived from the emissions pathways of each region and sector, which are the outputs of Integrated Assessment Models (IAM). These reduction requirements are combined with property-specific data such as energy intensity and building carbon intensities.

Real estate emissions at the building level can be separated in different categories according to the Greenhouse Gas Protocol.

- Scope 1 emissions are direct emissions related to fossil fuel burnt on-site and fugitive emissions related to fluorinated gases.
- Scope 2 emissions are indirect emissions related to the consumption of electricity and district heating / cooling.
- Scope 3 emissions are indirect emissions from any other downstream or upstream activities such as tenants' emissions. In the real estate sector, tenants' emissions are one of the main sources of Scope 3 emissions. In the MSCI Real Estate Climate VaR model, we include these emissions included in Scope 1 and 2.

In the MSCI Real Estate Climate VaR model, all these emissions are ultimately summed to determine the collective emissions related to building use. Decarbonization pathways also use this "whole building" emissions approach.

Emissions pathways are computed using NGFS data. In the MSCI Transition Climate VaR model, costs are computed until 2050 and are considered null afterwards.<sup>41</sup>

<sup>39</sup> "Energy Efficiency: Buildings." IEA. 2019.

<sup>40</sup> Please note that the results were based on pro-forma data that we computed for GPIF as of July 2023. The results using the published data may differ from the results based on pro-forma data.

<sup>41</sup> The reason for this is manifold. Many countries, companies and investors have set net zero emission targets and many countries already have their net zero targets codified in law or in policy documents. Taking these targets at face value would have most of the climate transition over by the objective date of 2050. This would mean that costs related to reducing emissions or complying with regulations would be over around 2050. There is uncertainty around how climate transition policies could evolve after 2050 and the costs associated with them given that the most economically viable reductions would have been made between today and 2050. The only reductions left would be from very hard to abate sources that would have massive marginal abatement costs that are no longer economically viable.

First, we calculate country/property type-specific intensity pathways per scenario, country and sector. We obtain the regional absolute emissions pathways and regional floor area pathways of the building stock from the REMIND IAM and NGFS. We then calculate the regional carbon intensity pathways by dividing the regional absolute emissions pathways by the regional floor area pathways. The pathways for each country and property type until 2050 are obtained by scaling down the regional carbon intensity pathways.

Secondly, we calculate asset-level emission intensity based on reported total emissions or reported energy consumptions. If total emissions or energy consumptions are not provided by the client, then country and property type-specific market averages are used as a proxy. In the case of assets located in Japan, the CRREM (Carbon Risk Real Estate Monitor) emission intensity values are used as a basis to compute the market average emission intensities.

By using the decarbonization pathway for a specific asset, based on the data calculated in the first step and the asset's current intensity from the second step, we calculate intensity reduction requirements.

By multiplying the intensity reduction requirements with the floor area of the building, we calculate emission reduction requirements. We then multiply the emission reduction requirement with the carbon price obtained from the REMIND IAM to calculate yearly costs. Please note that the model cannot fully predict cost allocations. For example, some transition costs may be shared with the buildings' tenants. The total net present value is calculated by discounting the entire cost timeseries until 2050 using a Real Estate Model specific discount rate of 7.4%.<sup>42</sup> Finally, Transition Policy VaR is calculated as the present value of cost in relation to property value.

### The Physical Risk Model

The Physical Risk model assesses the potential cost of climate hazards on buildings, using climate data for the given locations of assets incorporating the hazards of extreme heat, extreme cold, fluvial and coastal flooding, tropical cyclones and wildfire.

For real estate, the Physical Risk model analyzes building damages caused by extreme weather events and additional costs related to temperature changes (e.g., additional cooling costs). It covers the chronic physical risks of extreme heat, extreme cold, as well as the acute physical risks of fluvial flooding, coastal flooding, tropical cyclones, and wildfire.

The core cost functions due to either damage or increased heating and cooling are shown below:

- Damage cost computations follow the equation: Costs from acute risk impacts = hazard intensity \* percentage of building damage for given intensity \* property value
- Additional chronic heating and cooling costs follow the equation: Costs = number of days with extreme temperature \* additional cooling/heating requirements per day \* costs per kWh

First, we analyze climate scenarios to identify changes in extreme event frequency and intensity until the end of the century. Second, we extract physical hazard information such as the number of days with extreme temperature or the wind gust modeled for a tropical cyclone. Then we derive real estate sector vulnerabilities for simulated physical hazard intensities. Vulnerability is expressed as percentage of building value damaged per event. Additional cooling/heating requirements per day are expressed in kWh per square meter. Costs are calculated using the equations defined above in this section. Additional future costs are discounted at an annual rate of 7.4 % as we do for the

<sup>42</sup> Global average annualized total return of the MSCI Global Property Index.

Transition Policy Risk model to present the net present value. Finally, Physical Risk VaR is calculated as the present value of the aggregated additional future costs in relation to property value.

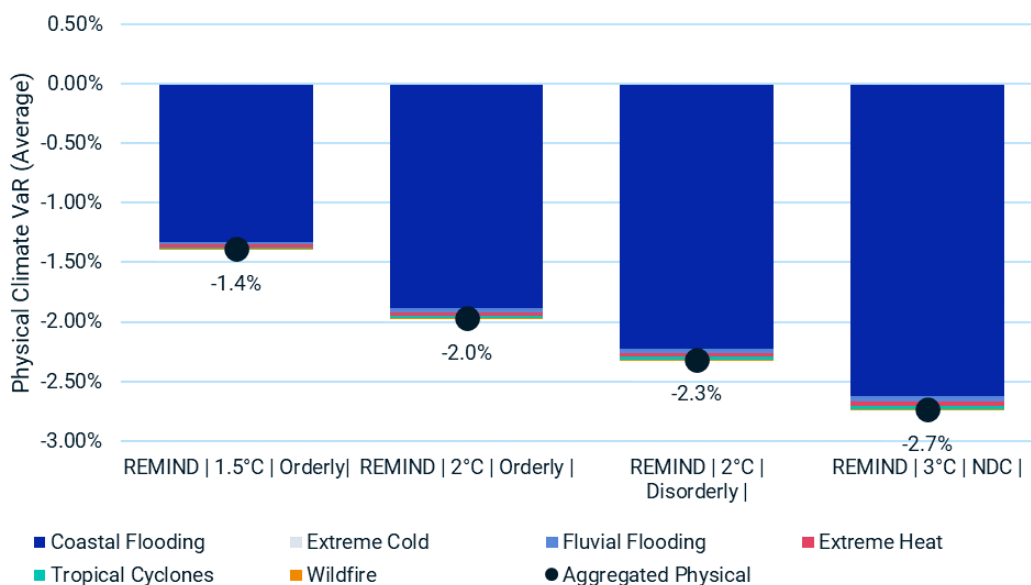
MSCI ESG Research uses a probabilistic modeling framework to determine the distribution of the annual cost from weather extremes for assets at a given location. This approach allows us to determine the average cost from climate change while also exploring the possibility of much more severe outcomes. We calculate the average scenario by considering the expected value of the cost distribution. We used this average scenario for the analysis of GPIF portfolio.

## Results for GPIF’s real estate portfolio

The real estate portfolio of GPIF contained reported energy consumption data for nearly half of the assets. Where available, the reported energy consumptions were used to compute emissions, otherwise emission intensity proxy numbers based on CRREM data were used.

Physical Risk VaR was the lowest for the 1.5°C scenario and highest for 3°C scenario (Exhibit 32). For hazard types, Coastal Flooding accounted for most of the Physical Risk VaR for GPIF’s FY2022 portfolio (Exhibit 32).

**Exhibit 32: Physical Risk VaR of GPIF’s FY2022 domestic real estate portfolio across four REMIND scenarios (Average)**



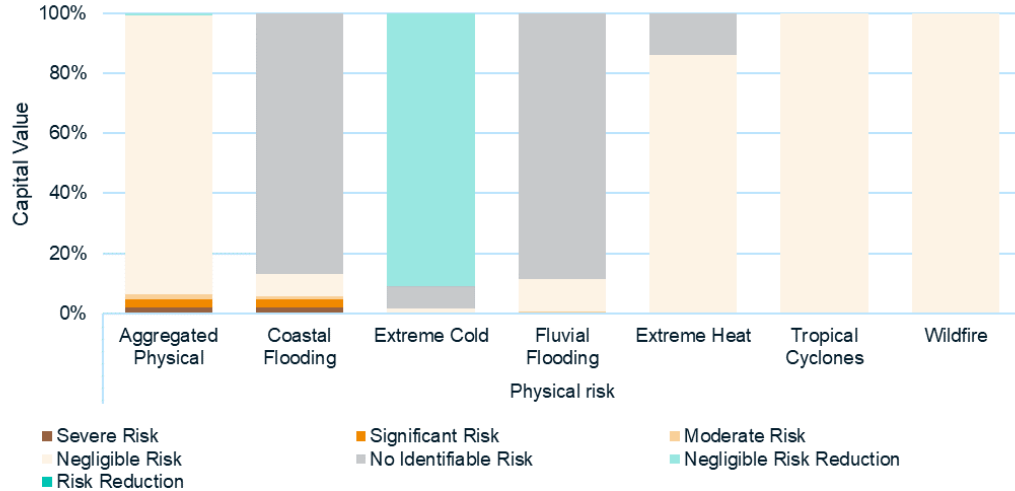
Source: MSCI ESG Research

“Average” refers to the use of average expected values from the model’s cost distribution

Based on absolute thresholds, we set the Financial Risk Category, which indicates an asset’s broad risk level associated with a Climate VaR for a given scenario. Categories include: Severe Risk (VaR<-25%), Significant Risk (VaR<-5%), Moderate Risk (VaR<-0.5%), Negligible Risk (VaR<0%), No Identifiable Risk (VaR=0%), Negligible Risk Reduction (VaR>0%), and Risk Reduction (VaR>0.5%). In the REMIND 1.5°C Orderly scenario, while there was about 5% of assets under

Severe Risk or Significant Risk due to coastal flooding, the majority of assets fell under Negligible Risk (Exhibit 33).

**Exhibit 33: Physical Risk VaR of GPIF's FY2022 domestic real estate portfolio under the REMIND 1.5°C Orderly scenario (Average) – percentage of capital value per risk category**

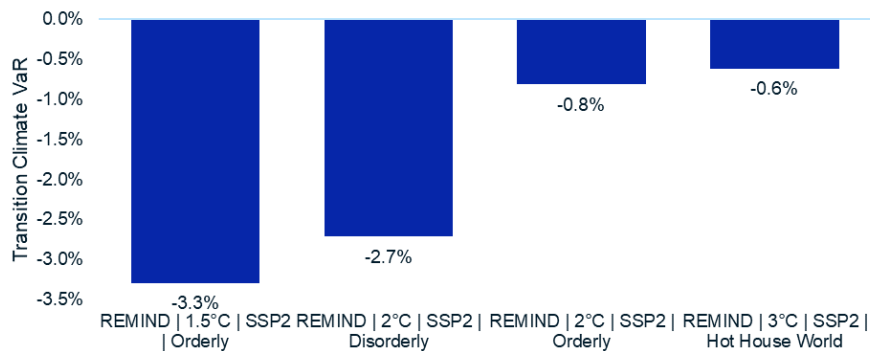


Source: MSCI ESG Research

“Average” refers to the use of average expected values from the model’s cost distribution

On the other hand, Transition Policy VaR showed the largest impact under 1.5°C REMIND Orderly Scenario, SSP2 (Net Zero 2050), followed by 2°C REMIND Disorderly Scenario, SSP2 (Delayed Transition), 2°C REMIND Orderly Scenario, SSP2 (Below 2 Degrees), and 3°C REMIND Hot House World, SSP2 (NDCs) (Exhibit 34). This shows how stringent (1.5°C) policies designed to mitigate carbon emissions in the real estate sector will increase costs, while 3°C scenarios will present the highest physical risks.<sup>43</sup> Ultimately, climate change risks may manifest through both transition and physical risks. This real estate analysis may underscore the importance of considering climate-related risks for alternative assets as well as traditional assets for a universal owner.

**Exhibit 34: Transition Policy VaR of GPIF's FY2022 domestic real estate portfolio across four REMIND scenarios**



Source: MSCI ESG Research

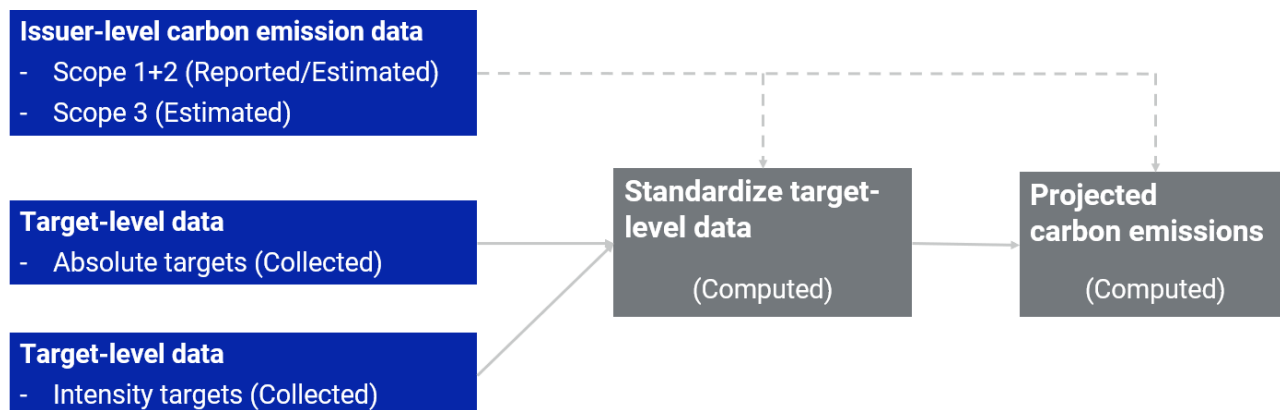
<sup>43</sup> Note that the model cannot fully predict cost allocations. For example, some transition costs may be shared with the buildings’ tenants.

## Appendixes

### Appendix I: Understanding the MSCI Target Summary Model

The Target Summary Model projects companies' future emissions only when companies have disclosed targets beyond a threshold level of detail. In the absence of a climate target with sufficient detail, MSCI ESG Research assumes a default emissions increase of 1% per year.

#### Exhibit 35: Process Flow for Incorporating Climate Target Data



Source: MSCI ESG Research, *Climate Targets and Commitments Methodology*, as of January 2022.

Notes: Intensity targets-based emissions projections depend on the growth rate chosen for the calculation's denominator. Absolute emissions can rise even if the headline intensity metric falls. The MSCI Target Summary Model thus normalizes intensity-based targets by applying a 1% growth factor to the denominator (i.e., production unit) over the period of the target.

Sufficiently granular target-level data is a key input when modelling the planned emissions trajectories of companies. In this section, we summarize seven types of data points that are required for emissions projections and progress of emissions reduction under the Target Summary Model. These target-level data points are relevant not only in modelling emissions projections, but they can also be key discussion points in issuer engagement efforts. The data points are as follow:

1. **Target type (e.g., absolute or intensity target. If intensity, intensity type)**
2. **Targeted scopes and categories**
3. **Emissions reduction percentages**
4. **Base year and base year emissions**
5. **Targeted year and targeted year emissions**
6. **Reported year and reported year emissions**
7. **Coverage ratios of targeted scopes and categories**

The table below shows examples of data from a hypothetical company to illustrate how the Target Summary Model standardizes a company's target-level data and projects its future emissions.

**Exhibit 36: Hypothetical company example of projecting future emissions using climate targets**

Hypothetical Company		Reported Year	Base Year	Target Years				
(1) Absolute Targets		(6) 2020 Emissions	(4) 2018 Emissions	(7) Target Coverage	(3) Reduction % 2030/2040/2050	(5) 2030 Emissions	2040 Emissions	2050 Emissions
(2) Scope 1 (MtCO2e)		5.1	6.81	100%	72%/ 100%/ 100%	1.91	0	0
Scope 2 (MtCO2e)		0.54	0.72	100%	72%/ 100%/ 100%	0.20	0	0
Scope 3 (MtCO2e)	C1+2	1.85	2.03	100%	45% / 82% / 100%	1.16	0.37	0
	C3	0.93	1.01	100%	45% / 82% / 100%	0.56	0.18	0
	C4+9	0.11	0.84	100%	45% / 82% / 100%	0.46	0.15	0
	C5	0	0	-	-	0.00	0.00	0
	C6	0	0	-	-	0.00	0.00	0
	C7	0	0	-	-	0.00	0.00	0
	C8	0	0	-	-	0.00	0.00	0
	C10	0	0	-	-	0.00	0.00	0
	C11	2.35	2.79	100%	45% / 82% / 100%	1.53	0.50	0
	C12	0	0	-	-	0.00	0.00	0
	C13	0	0	-	-	0.00	0.00	0
	C14	0	0	-	-	0.00	0.00	0
	C15	0	0	-	-	0	0.00	0
Total MtCO2e		10.88	14.2	-	-	5.82	1.20	0





Source: MSCI ESG Research. Based on a hypothetical company. The MSCI Implied Temperature Rise (ITR) model uses estimated Scope 3 emissions per category across all companies to maintain consistency, as company disclosures of this emission type vary considerably.

In the example above, a hypothetical company announced a net-zero target across Scope 1+2 emissions boundaries by 2040, and a net-zero target across all categories of its Scope 3 emissions by 2050. Its decarbonization strategies also included interim 2030 and 2040 targets to reduce its absolute Scope 1+2 emissions by 72% by 2030 and reduce Scope 3 emission by 45% and 82% by 2030 and 2040, respectively, both using 2018 as the baseline year.

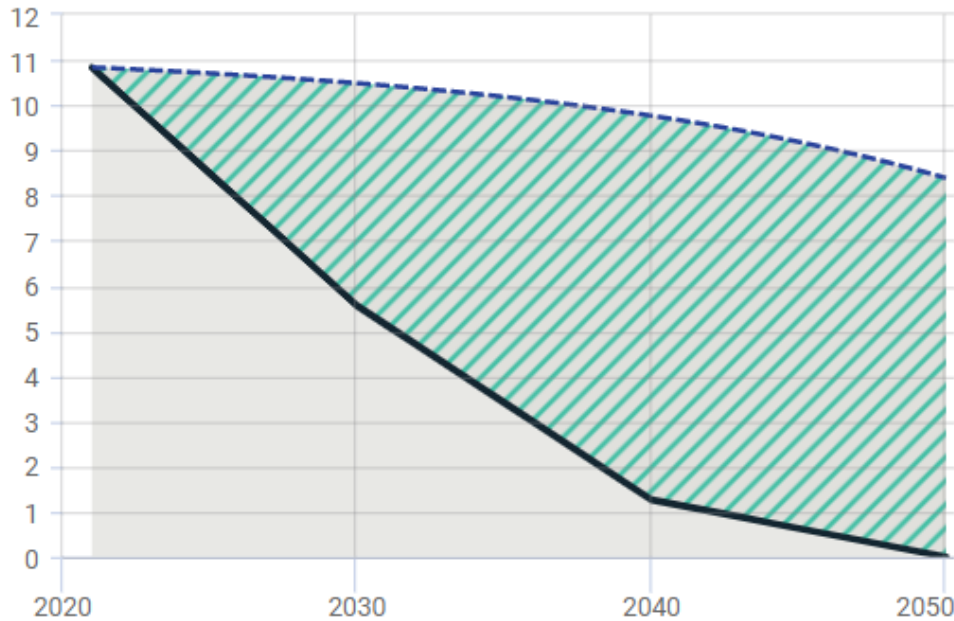
We also note that the MSCI's Implied Temperature Rise (ITR) Model (see following section) assesses a company's temperature alignment, using its target-based emissions projection estimated under the Target Summary Model. The bold black line in the chart below is an illustration of a company's target-based emissions projection used in the ITR model.

**Exhibit 37: Hypothetical company example of emissions trajectory and ITR**



-  Annual Projected Carbon Emissions
-  MSCI 2°C Trajectory (Annual Budget)
-  Absolute Carbon Budget Overshoot
-  Absolute Carbon Budget Undershoot

Absolute emissions [Megatons CO2e]



Source: MSCI ESG Research. Based on a hypothetical company.

Note: Illustration of projected emissions reduction assumed the hypothetical company would achieve the targets in the stated target years. \*The MSCI Implied Temperature Rise (ITR) model uses estimated Scope 3 emissions per category across all companies to maintain consistency, as company disclosures of this emission type varies considerably. MSCI Trajectory 2°C (Annual Budget) is based on current ITR model, while updated ITR model uses 1.5°C Trajectory.

Companies' target disclosures often lack specific information regarding a target's baseline year, baseline value for calculating GHG emissions reductions, target coverage, targeted reduction, as well as targeted year and expected emissions at the target year. These are regarded critical information, without which MSCI ESG Research cannot project a company's emissions into the future.

For certain cases, however, where the target description includes some critical information but is missing one partial element, MSCI ESG Research can use previously reported emissions data or minimal calculations to complete the target description and process the target into a company's future emissions projection.

To provide transparency for targets that used imputed as opposed to disclosed data by companies, MSCI ESG Research provided an additional factor under the target summary information explaining what exactly was imputed for each of the targets.

**Exhibit 38: Process flow for incorporating missing climate target data**

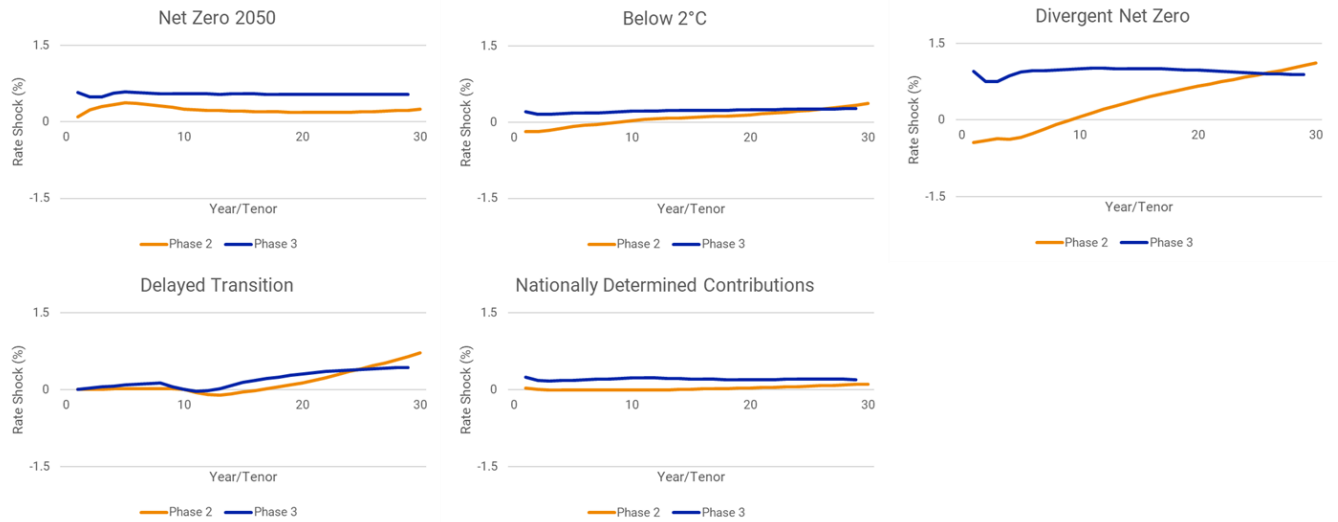
Step	Missing Data point	Imputation	Description
1	Target Value	Calculate target value from reported GHG emissions reduction %	If a target has a baseline GHG emission reduction value and a reduction percentage, target value can be calculated: (target value = baseline value * (1- reduction %)).
2	Target Value = 0	Impute target value for net zero targets	For a small set of net-zero targets the target value is missing – this effectively is zero. - Apply zero as the target value
3	Baseline Value	Impute GHG emissions baseline value for all targets	For a set of targets, the baseline year is reported but the baseline value for calculating a GHG emission target is missing. Use reported or estimated emission data for the corresponding year to impute the baseline. - E.g., Impute baseline value for 2019 (use 2018 reported value)
4	Baseline Year and baseline value	Impute GHG emissions baseline year and value for net zero targets	For net zero targets, baseline year and value for calculating a GHG emission target are missing. Use announcement year minus 1 year and reported or estimated emission data for the corresponding year as the baseline value
5	Target Coverage Ratio	Impute target coverage ratio as 100% when the target is applicable company wide.	For those companies that disclosed the target is applicable company wide, the Target Summary Model assumed the target coverage ratio of such targets as 100%.

Source: MSCI ESG Research



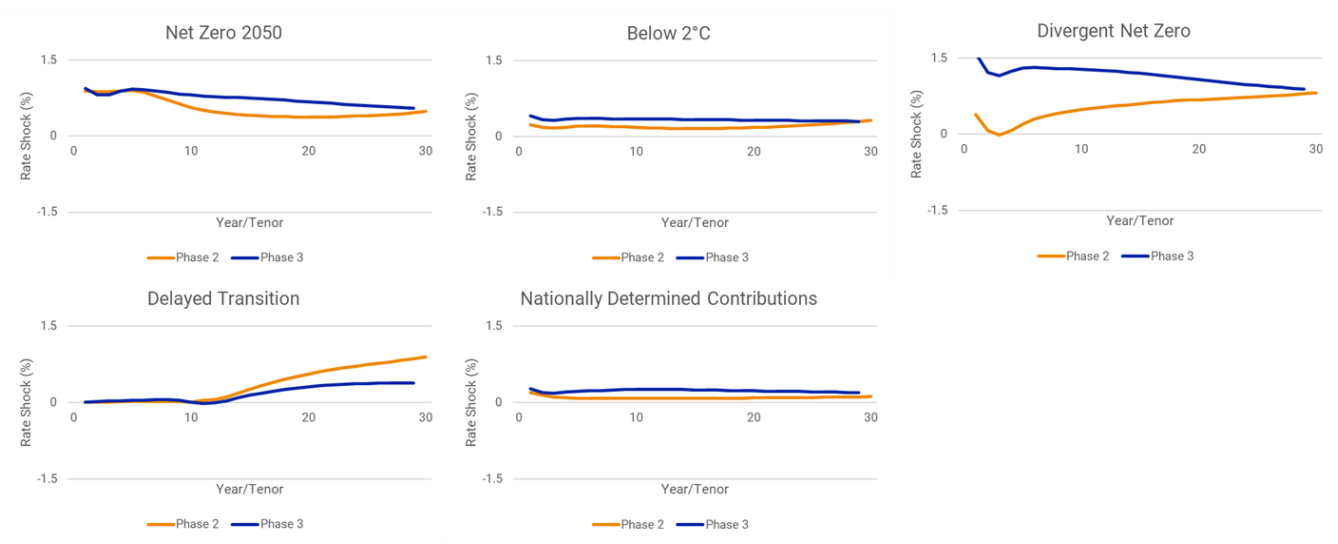
Appendix II: Comparison of yield curve shocks between NGFS phase II and phase III

**Exhibit 39: Comparison of yield curve shocks between NGFS Phase II and Phase III for the GPIF's Japanese bond holdings**



Source: MSCI ESG Research, as of June 2023

**Exhibit 40: Comparison of yield curve shocks between NGFS Phase II and Phase III for the GPIF's U.S. bond holdings**



Source: MSCI ESG Research, as of June 2023

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