GPIF

Supplementary Guide to GPIF ESG Report 2021

Analysis of Climate Change-Related Risks and Opportunities in the GPIF Portfolio

For All Generations

Introduction: Challenges to Address and Key Points of This Report

Foreword

Climate change risk affects all asset classes and securities simultaneously, cannot be eliminated through diversification, and has a very high likelihood of materializing in the long term. Based on such recognition, GPIF adopted the S&P Carbon Efficient Index series as a passive investment benchmark in Fiscal Year 2018. The index reflects the carbon efficiency of companies and other factors in determining index constituent weightings. We also declared support for the recommendations of the TCFD (Task Force on Climate-related Financial Disclosures) in the same year. In 2019, we incorporated the "Climate-related Financial Disclosure" in the “ESG Report 2018” in line with the TCFD recommendations. Since then we have been working to analyze risks and opportunities associated with climate change and to reflect them in our investment decisions. Furthermore, in 2020, we published the report "Analysis of Climate Change-Related Risks and Opportunities in the GPIF Portfolio" as a supplementary guide to the “ESG Report 2019” and introduced more detailed analysis. This report is the third issue of "Analysis of Climate Change-Related Risks and Opportunities in the GPIF Portfolio.”

The report series "Analysis of Climate Change-Related Risks and Opportunities in the GPIF Portfolio" has evolved over the years. The 2019 edition adopted the Climate Value-at-Risk (CVaR) analysis for the first time, to comprehensively assess the financial impact on the portfolio through not only "policy risk," but also "technology opportunities," which evaluate environmental technology-related patents, as well as "physical risks and opportunities." In the following edition of FY2020, the scope of greenhouse gas (GHG) emissions was expanded to the entire supply chain, and alternative assets were partially included in addition to traditional assets such as equities and corporate bonds.

In this report, we put emphasis on conducting analysis based on the same assumptions. For example, the climate analysis was conducted based on the scenarios published in June 2021 by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS), a network of major central banks and financial authorities around the world. It is important to use the same criteria for evaluation and analysis under common assumptions to improve accuracy and objectivity. With regards to "using the same criteria," various initiatives are underway around the world not only for climate-related disclosure, but also for ESG disclosure in general. We will continue to monitor the developments.

The recent extreme weather conditions seem to force us to change our views on climate change risks. Droughts in Europe dropped water levels in rivers disrupting not only fuel transport, but also becoming a major obstacle to cool down hydroelectric and thermal power generation. These events

are occurring under the limited natural gas supplies from Russia. Combined with the supply constraints by geopolitical risks, it is becoming a major cause for concern for the European economy. Acute physical risks such as droughts gradually increase probability of occurrence due to climate change, while the risk events can suddenly become apparent on any given day. Adverse effects can be amplified many times over, depending on the external environment. Although investors often view that physical risks are transient, and its impact may be localized, the European drought was enough to change this mindset. In reality, it is extremely difficult to accurately assess climate change and its associated risks and opportunities, and therefore, the results of this analysis should be interpreted in a broader context. We hope, however, that the analysis presented in this report will help investors and companies alike to consider such risks and opportunities in depth.

Composition and Analysis Highlights

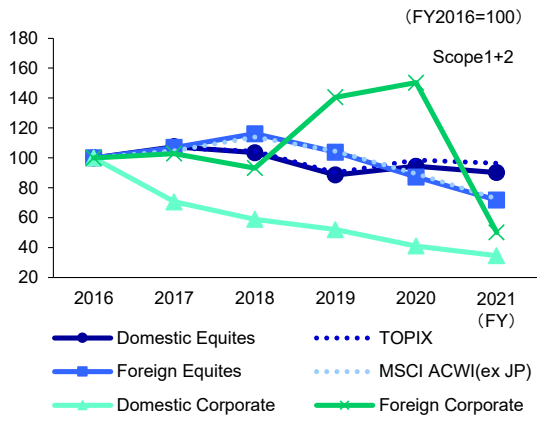
This report has two sections: an introduction (previous section) and a main body. The main body consists of four chapters.

In Chapter 1: Analysis of Portfolio GHG Emissions the carbon footprint (GHG emissions) and carbon intensity (GHG emissions per unit of revenue) of the Government Pension Investment Fund (GPIF) portfolio were measured using S&P Trucost data. Similar to last year, the scope of the GHG emissions analysis is the entire supply chain, but emission trends are calculated based on Scope 1 and Scope 2 for the data consistency. GHG emissions have generally declined in all asset classes. Changes in companies held and size of holdings in the portfolio are the main cause of this trend, but with the most recent data, decreasing emissions of portfolio companies is also a factor (Figure 0-1).

The report also introduces Corporate Disclosure of GHG emissions. Although domestic companies have lagged foreign companies in disclosing information on GHG emissions, there are indications that they have been catching up significantly in recent years.

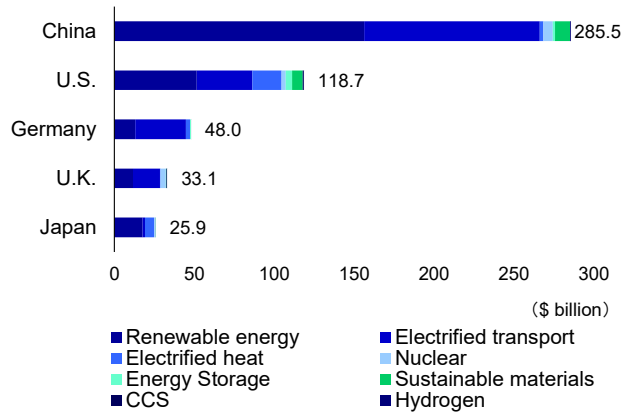
Chapter 2: Public- and Private- Sector Support for Achieving a Net-Zero Economy summarizes the carbon policies of various countries and the status of setting corporate decarbonization targets. The number of countries committing to carbon neutrality has been increasing, and more than 99% of the world's GDP and GPIF's portfolio companies are steering toward carbon neutrality based on the country of domicile. Investment in decarbonizing technologies has been growing rapidly, with China leading with $285.5 billion in investment in 2021 (Figure 0-2). According to BloombergNEF, global investments in these technologies will need to reach approximately $4.2 trillion a year in between 2026 to 2030 from the current investment amount of $0.8 trillion in 2021, in order to reach net zero by 2050.

Figure 0-1 GHG Emission Trends



(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Figure 0-2 Amounts Invested in Decarbonization Technologies in 2021 (by Country and Technology)



(Note) Investment amounts in 2021
(Source) BloombergNEF, GPIF

Chapter 2 also analyzes the private sector's movement toward carbon neutrality. The number of companies with GHG reduction targets has been increasing every year. By the end of 2021, 29.4% of the world's major companies, listed in MSCI ACWI Investable Market Index, have set reduction targets. In particular, the number of companies setting long-term targets for achieving net-zero GHG emissions has been steadily increasing, while the number of companies with reduction targets for their entire supply chain, including Scope 3 is still limited.

We also used MSCI's Implied Temperature Rise (ITR) to assess the extent of potential to cause global warming from a target company's forecast greenhouse gas emissions, shown as increase in temperature. The results of the analysis showed that the temperature rise potential across GPIF's portfolio was 2.7°C for domestic equities, 2.4°C for domestic bonds , 2.7°C for foreign equities, and 2.7°C for foreign bonds, indicating that there is still some distance from achieving the Glasgow Climate Pact, which was set as a result of the latest UN Climate Change Conference, COP26 in November 2021,to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels.

TPI (Transition Pathway Initiative) Management Quality Score (MQ Score) was developed to rate company's management of greenhouse gas emissions and the quality of their responses to risks and opportunities related to the transition to a low-carbon economy. In this analysis, MQ Score was examined to see whether the level of the scores affected the subsequent improvement of companies' carbon intensity. The results showed that commitments to climate change and other factors influenced their future improvements in carbon intensity.

In Chapter 3: Analysis of Climate Value-at-Risks, MSCI's Climate Value-at-Risk (CVaR) was used to evaluate the financial impact of climate change risks and opportunities on GPIF's portfolio (impact on asset price). The main improvements in the analysis this year are (1) the adoption of climate scenarios published in June 2021 by the Network of Financial Authorities on Climate Change Risks (NGFS), and (2) the ability to assess the impact on government bond prices for each NGFS climate scenario. It is a major step forward that equities, corporate bonds, and government bonds can now be analyzed under the same assumptions based on highly neutral scenarios adopted by major central banks.

The NGFS presents six scenarios based on high and low physical and transition risks (Figure 0-3).

Figure 0-3 Six NGFS Scenarios

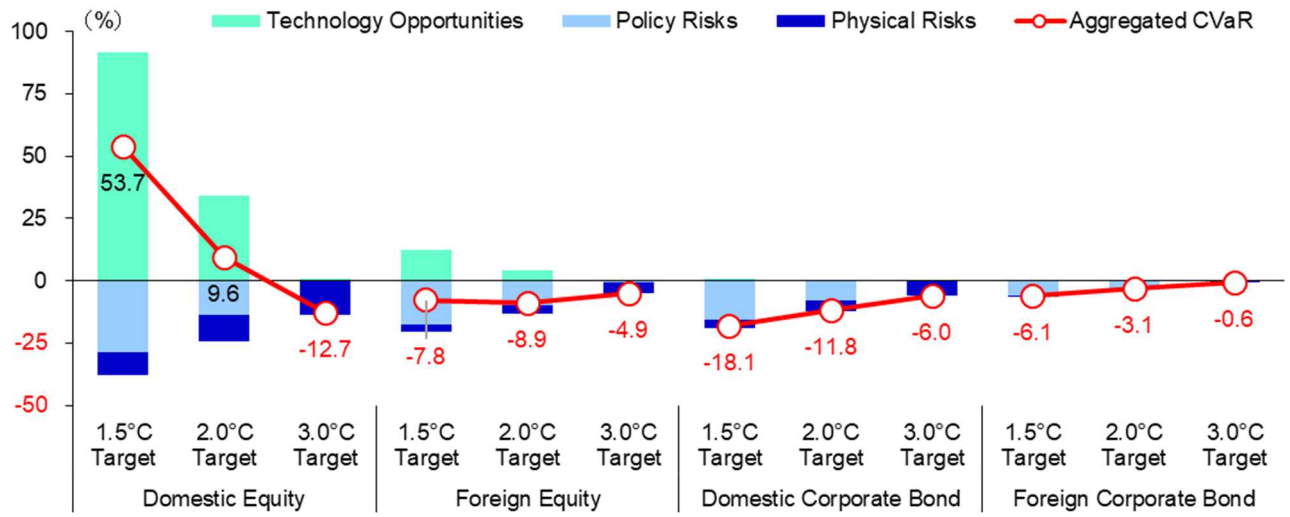
Category	Scenario	Physical Risks	Transition Risks	Temperature Rise	Policy Reaction	Technology Change	CO_2 Removal (CDR)	Regional Policy Variation
Orderly	(1) Net Zero 2050	Low	1.5°C	Medium	Immediate, smooth	Fast change	Medium use	Medium variation
	(2) Below 2°C	Medium	1.7°C	Medium	Immediate, smooth	Moderate change	Medium use	Low variation
Disorderly	(3) Divergent Net Zero	Low	1.5°C	High	Immediate but divergent	Fast change	Low use	Medium variation
	(4) Delayed Transition	Medium	1.8°C	High	Delayed	Slow/ Fast change	Low use	High variation
Hot House World	(5) Nationally Determined Contributions: NDCs	High	Up to 2.5°C	Low	NDCs	Slow change	Low use	Low variation
	(6) Current Policies	High	3°C+	Low	None/Current Policies	Slow change	Low use	Low variation

(Note) “Temperature rise” refers to the rise in temperature from pre-industrial levels to the end of the 21st century. Red cells indicate a high level of risk, while blue cells indicate a low level of risk.
(Source) Prepared by GPIF based on NGFS Climate Scenarios for Central Banks and Supervisors (June 2021), etc.

Based on the six scenarios of the NGFS, we took the average of each scenario near the 1.5°C, 2°C, and 3°C targets for simplicity to see the average figure for each temperature increase scenario. Similarly to previous years', domestic equities are having a major positive impact from technology opportunities, driven by strict environmental policies (Figure 0-4). In terms of climate change risk to government bonds, yield curves were produced for each scenario for the countries being analyzed based on the 30-year interest rate forecasts by the NGFS’s framework and compared them to the base scenario to measure the impact of changes in government bond prices on the portfolio. As the world steers toward a net-zero policy, driving higher interest rates, the GPIF's government bond portfolio may receive negative impacts (Figure 0-5 and Figure 0-6).

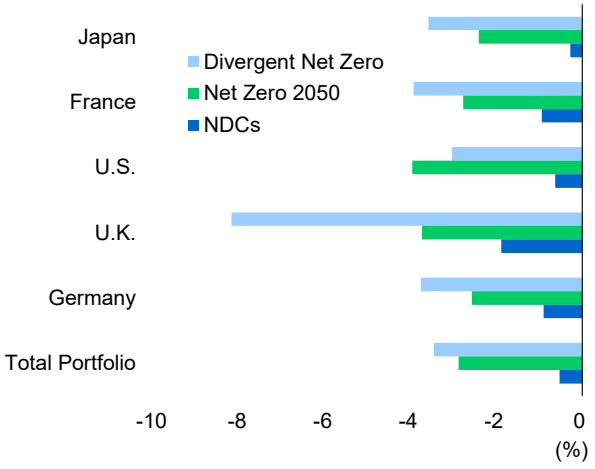
In Chapter 4: Other Analysis, the analysis is not limited to climate change, but includes the SDGs.

Figure 0-4 Comparisons of CVaR by Temperature Rise Scenario



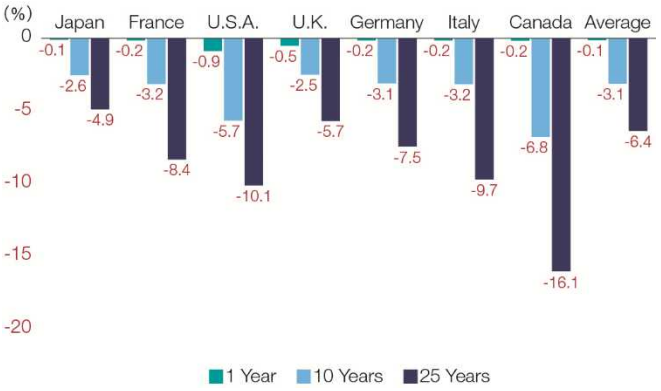
(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC ©2022.

Figure 0-5 CVaR of Government Bonds by Sector



(Note) Selecting only some scenarios
(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC©2022

Figure 0-6 Country-to-country Comparison of Rate of Decline in Government Bond Prices (1-Year, 10-Year, and 25-Year Maturity)



(Note) The average is a simple average of 46 countries, including the above seven countries.
(Note) The analysis is based on "Net Zero 2050" scenario.
(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC©2022

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Chapter 1: Analysis of Portfolio GHG Emissions

Features of GPIF's Portfolio

Breakdown of GPIF Portfolio by Asset, Sector and GHGs

The analysis looked at four asset classes in GPIF's portfolio: domestic bonds, foreign bonds, domestic equities, and foreign equities. Alternative assets[1] and short-term assets were not included in the analysis. In the sections that follow, we analyze the measurement of GHG emission volumes ("GHG emissions") and transition risks[2], as well as analyzing the physical risks[3] relating to these four asset classes, using data as of March 31, 2022. Because analysis results are heavily influenced by the investment amount and sector weighting of each asset class, it is important to understand the characteristics of our portfolio prior to interpreting these results.

The GPIF portfolio is composed of roughly half bonds and half equities by overall market value. As of March 31, 2022, domestic bonds accounted for 26.33% of the total portfolio, foreign bonds for 24.07%, domestic equities for 24.49%, and foreign equities for 25.11% (Figure 1-1). The majority of bond holdings, both domestic and foreign, consists of government bonds and government-related bonds (Figure 1-2).

When examining GPIF's equity portfolio by sector, there is a difference in the composition of the domestic and foreign equity portfolios (Figure 1-3). The domestic equity portfolio has a higher proportion invested in the relatively high-emitting industrials and consumer discretionary sectors, while the foreign equity portfolio has a high proportion in the low-emitting information technology, financials, and healthcare sectors.

There is also a difference in the composition by industry sector in GPIF's corporate bond portfolio between domestic bonds and foreign bonds. Looking at the corporate bond portfolio, financials accounted for the largest proportion for both domestic and foreign bond portfolios (Figure 1-4). Among domestic corporate bonds, the proportion invested in the utilities and consumer discretionary sectors is higher than that for foreign corporate bonds. Among foreign corporate bonds, the proportion invested in the high-emitting energy sector is higher than that for domestic corporate bonds, but there is also a high proportion invested in the low-emitting sectors of telecommunications services, healthcare, and information technology.

The next figure looks at characteristics in GHG emissions by asset class and industry sector (Figure 1-5). The data shown here is for GHG emissions per million yen of sales. Emissions are high in the

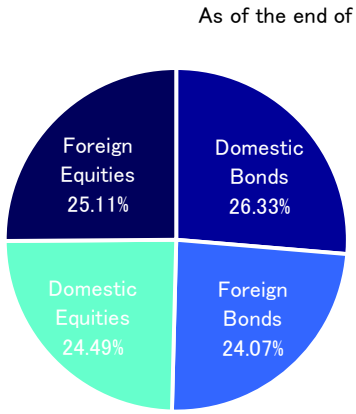
1 Alternative assets account for around 1.07% of the pension reserve fund, and are generally allocated to the four main portfolio asset types according to their characteristics.

2 Transition risks are risks that arise from policy, technological innovation, demand change, etc. that accompany the transition to a low-carbon economy..

3 Physical risks are risks from direct damage to an asset, supply chain disruption, etc., resulting from climate change.

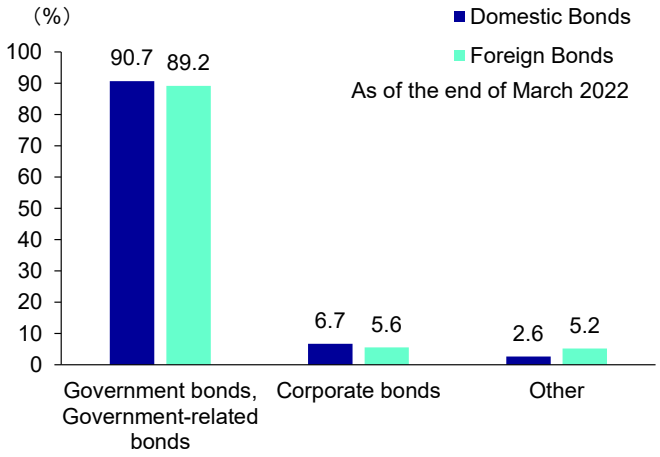
energy, utilities, and materials sectors in both equity and corporate bond portfolios. Since the energy sector includes oil and coal companies, the utilities sector includes electric power companies, and the materials sector includes chemicals, iron and steel manufacturers, these three sectors tend to emit higher GHG emissions than other sectors. GHG emissions data coverage of GPIF's portfolio was 99.7% for domestic equities, 98.9% for foreign equities, 96.4% for domestic bonds, and 89.8% for foreign bonds.

Figure 1-1 Breakdown of Portfolio Asset Types (Total for GPIF's Pension Reserves)



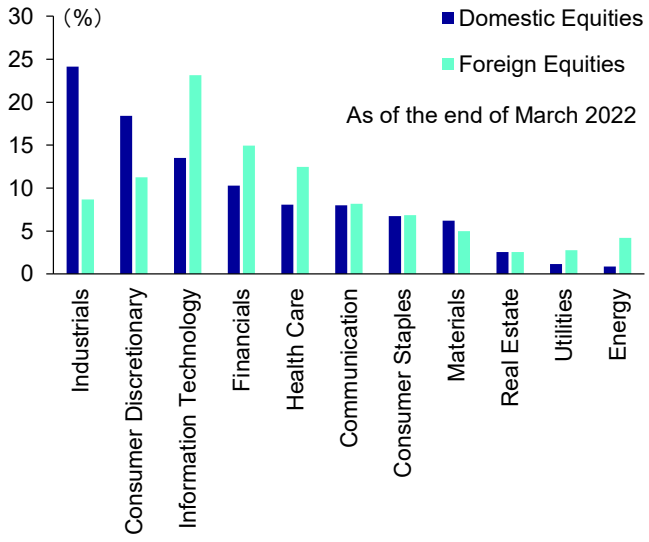
(Source) GPIF

Figure 1-2 Breakdown by Category in GPIF Bond Portfolio



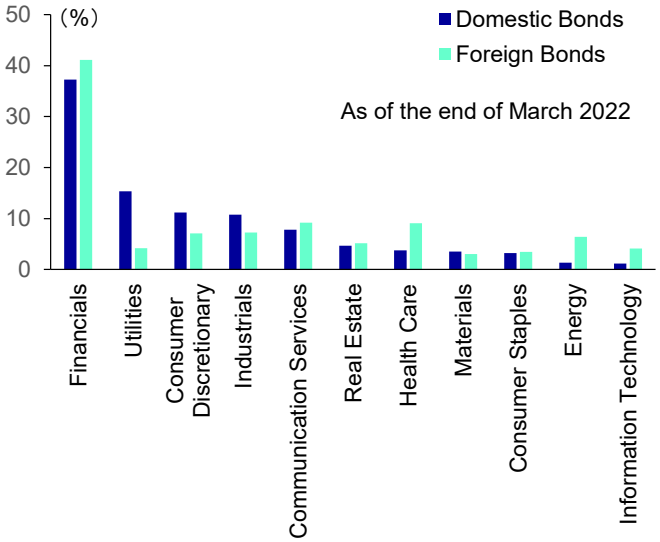
(Note) "Other" includes securitized products.
(Source) GPIF

Figure 1-3 Breakdown of GPIF Equity Portfolio by Sector Based on Total Market Value



(Source) GPIF

Figure 1-4 Breakdown of GPIF Bond Portfolio by Sector Based on Total Market Value



(Note) Among Domestic and Foreign Bonds, only corporate bonds are analysed.
(Source) GPIF

Figure 1-5 Carbon Intensity by Sector

	Domestic Equities		Foreign Equities		Domestic Bonds		Foreign Bonds	
	Scopes 1 + 2 + 3	Scopes 1 + 2	Scopes 1 + 2 + 3	Scopes 1 + 2	Scopes 1 + 2 + 3	Scopes 1 + 2	Scopes 1 + 2 + 3	Scopes 1 + 2
Communication Services	1.31	0.23	1.10	0.27	1.36	0.33	0.99	0.27
Consumer Discretionary	8.61	0.40	7.06	0.42	11.26	0.30	9.24	0.44
Consumer Staples	4.81	0.61	5.84	0.64	3.76	0.48	8.05	0.79
Energy	27.48	2.63	51.58	5.01	26.80	2.61	47.30	4.62
Financials	0.66	0.07	1.30	0.18	0.94	0.08	1.95	0.06
Health Care	1.06	0.26	1.10	0.15	1.06	0.20	1.06	0.26
Industrials	13.15	0.95	13.51	1.19	7.21	1.89	11.69	2.00
Information Technology	3.12	0.47	2.85	0.44	4.56	0.99	2.62	0.25
Materials	14.86	6.23	30.23	9.39	14.69	6.63	27.18	6.44
Real Estate	2.89	0.29	3.45	1.04	2.75	0.45	3.25	1.06
Utilities	20.67	8.24	27.28	17.25	12.60	7.89	27.36	14.85

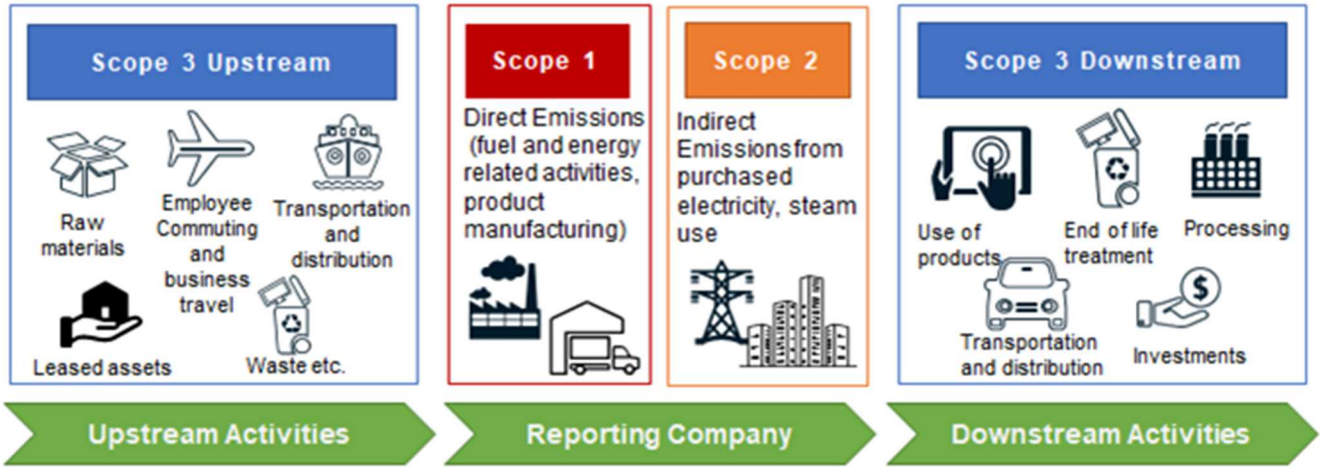
(Note) Top 3 carbon intensive sectors are highlighted in gray. Among Domestic and Foreign Bonds, only corporate bonds are analysed. Aggregation range of GHG is Scope 1, 2, and 3. Securitesthat are 1% above or below the percentage change from the previous year in GHG emissions are excluded from the calculation as outliers. Data is as of the end of March 2022. (GHG emissions are calculated from data available as of March 31, 2022.)
(Note) GHG emissions are the carbon footprint allocated based on the percentage of the value of company's equity and corporate bond holdings. The allocated portion is calculated with the value of the company's equity and corporate bond holdings as the numerator and the enterprise value including cash (EVIC) as the denominator at the time of analysis.
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Scope of Equities and Corporate Bonds Analyses

Greenhouse Gas Emissions by Sector Significantly Affected by Scope 3

Since last fiscal year, we have expanded the calculation scope of GHG emissions to include indirect emissions from the consumption and use of sold products and services (Scope 3 downstream) in addition to direct emissions by the company itself (Scope 1), indirect emissions related to purchased electricity (Scope 2), and indirect emissions from procured products and services other than purchased electricity (upstream Scope 3) (Figure 1-6). Figure 1-7 shows emissions[1] for the equity and bond portfolios at the end of FY2021 by sector and by scope. Looking at the equity portfolio, "Industrials," "Consumer Discretionary," "Materials," and "Energy" have high GHG emissions and furthermore, the percentage of downstream Scope 3 in total emissions is also very high. The same trend is observed in the Corporate bond portfolio. Caution is required when analyzing portfolios with a higher weight of companies in these sectors, as analysis results change significantly depending on whether or not Scope 3 is included in the calculation. In the analyses below, the year-to-year percentage change in GHG emissions of plus or minus 1% have been excluded from calculations as outliers. Further, many companies do not disclose their Scope 3 emissions, leading to a dependence on estimates from models. For this reason, scope 3 emissions are excluded from calculations of emission trends (Figures 1-9 and 1-14).

Figure 1-6 Greenhouse Gas Emissions by Scope

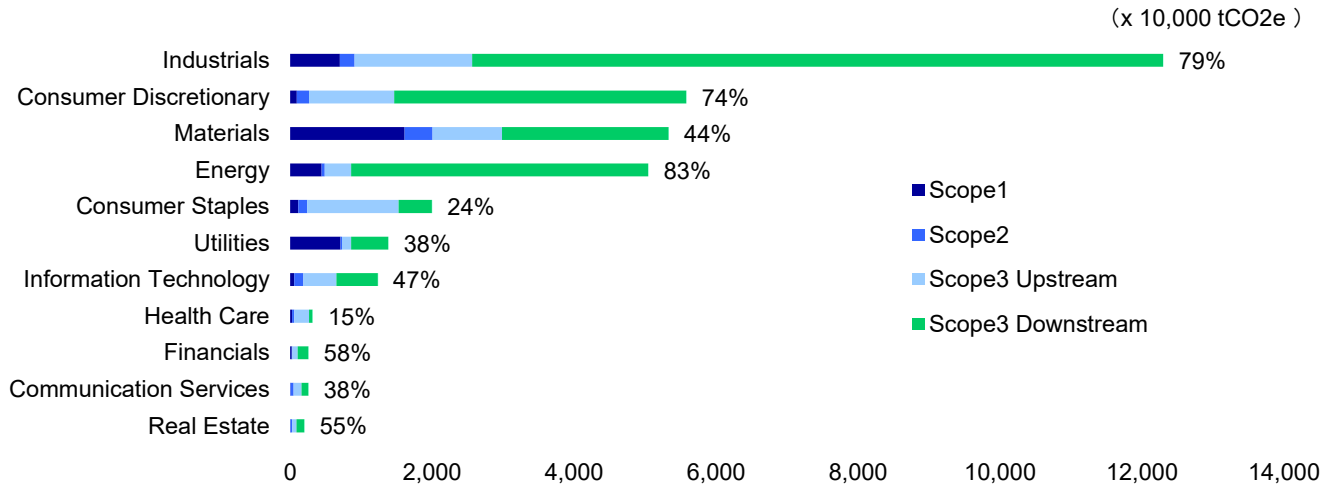


(Note) The above figure indicates the major activities included in each scope.
(Source) Created by GPIF based on the Greenhouse Gas Protocol.

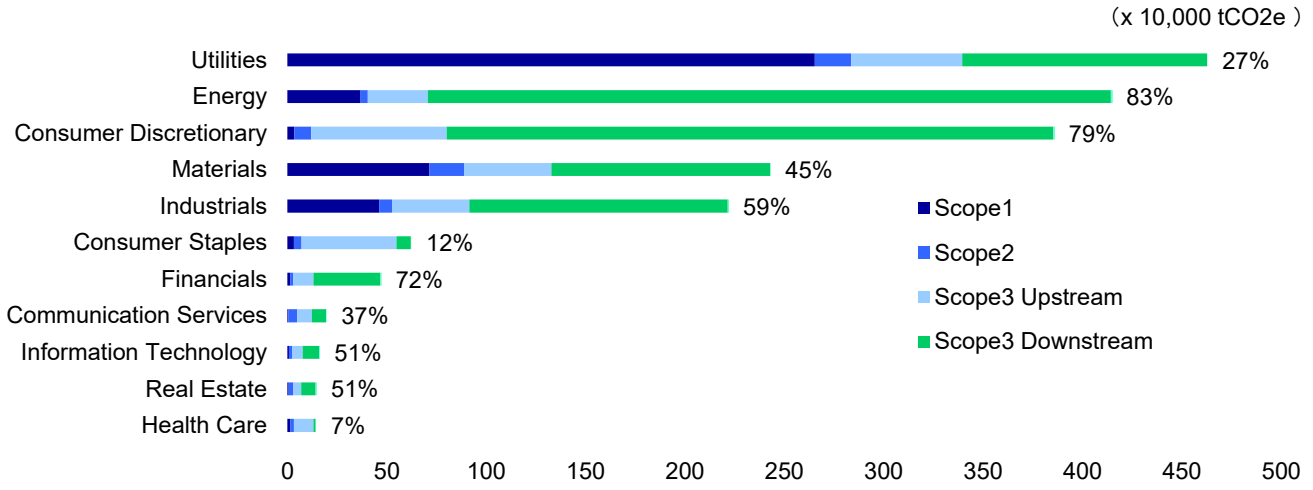
[1] Carbon footprint is apportioned based on the percentage of the stocks/bonds holdings of the issuing companies. The apportion is calculated using the size of the holding in stocks/bonds in the issuing companies at the time of analysis as the numerator and the enterprise value including cash (EVIC) as the denominator.

Figure 1-7 GHG Emissions by Scope

Equity Portfolio



Corporate Bond Portfolio



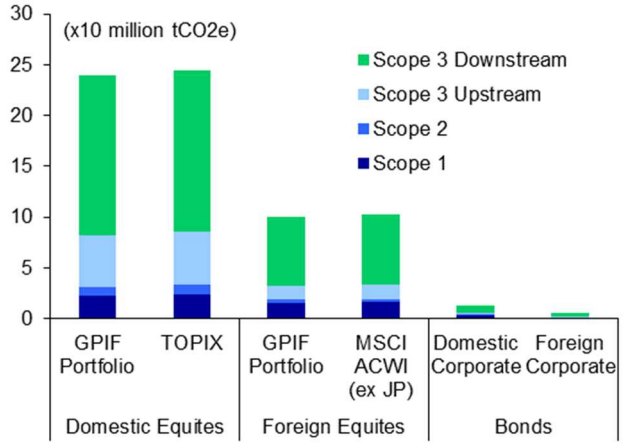
(Note) Available data as of March 31, 2022.
(Note) Numbers on graph are the percentage of Scope 3 Downstream emissions to total emissions.
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Carbon Footprint (GHG Emissions) Analysis

Carbon Footprint by Asset

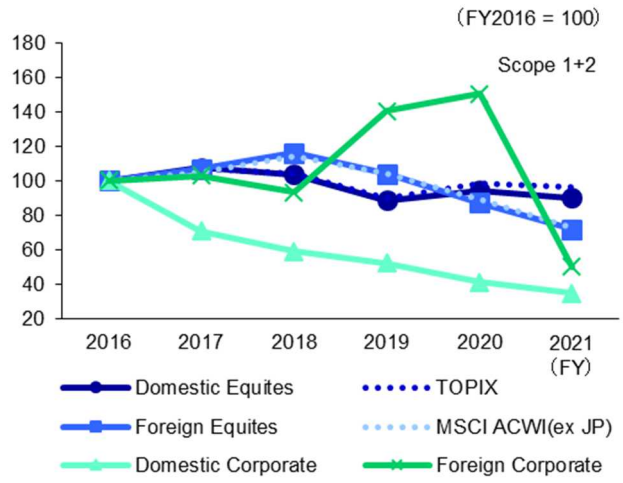
Figure 1-8 shows the calculation of Scope 1-3 emissions[1] for the equity and bond portfolios as of the end of FY2021. Looking at the total GHG emissions by asset class, domestic equities were found to have the highest level of emissions, followed by foreign equities, domestic corporate bonds, and foreign corporate bonds. This primarily reflects the relative size and sector of holdings of each asset class within GPIF's portfolio as shown in Figures 1-2 to 1-5. GHG emissions of domestic equities are much higher than those of foreign equities, mainly due to the large allocation to "Industrials," which have a high GHG emissions. The breakdown of GHG emissions in each asset class shows that Scope 3 accounts for the major proportion of total emissions for all assets. This would suggest that identifying GHG emissions across the entire supply chain, not just the company itself, is crucial for the implementation of efficient emission reduction measures. Figure 1-9 shows GHG emission trends of combined Scope 1 and 2, using 100 for fiscal 2016 emissions as a base. In the five years from fiscal 2016, GHG emissions have generally declined in all asset classes. Changes in companies held and size of holdings in the portfolio are the main cause of this trend, but in the most recent data, decreases in emissions, as seen in recent TOPIX and MSCI ACWI (ex JP) figures, are also a factor (Figure 1-11 and 1-12).

Figure 1-8 Greenhouse Gas Emissions by Scope



(Note) Data available as of March 31, 2022.
(Source) Prepared by GPIF based on data from S&P.
S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Figure 1-9 Greenhouse Gas Emission Trends



(Source) Prepared by GPIF based on data from S&P.
S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

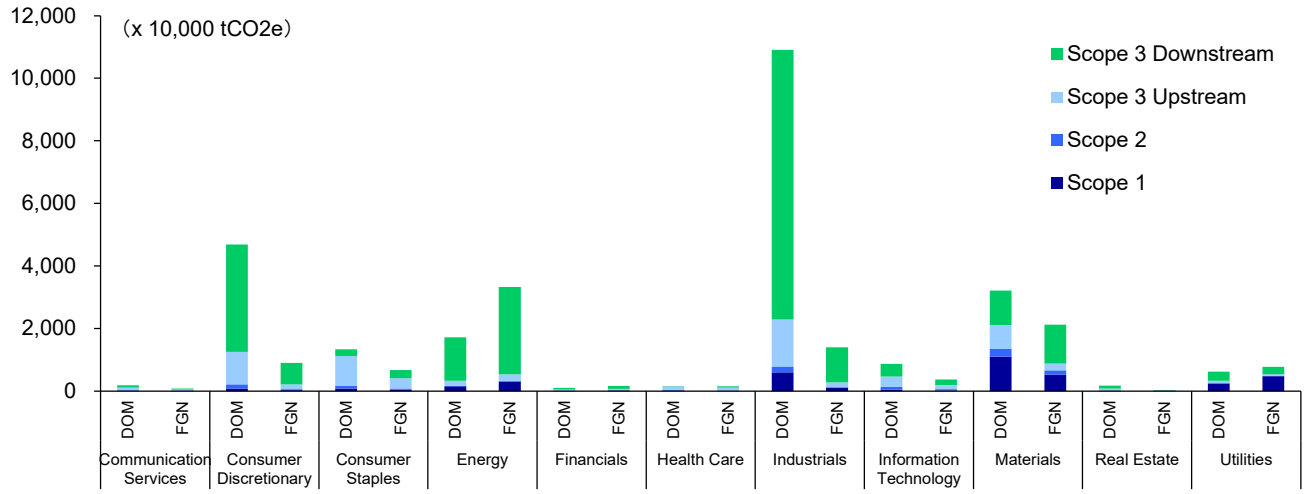
[1] Carbon footprint is apportioned based on the percentage of the stocks/bonds holdings of the issuing companies. The apportion is calculated using the size of the holding in stocks/bonds in the issuing companies at the time of analysis as the numerator and the enterprise value including cash (EVIC) as the denominator.

Carbon Footprint (GHG emissions) by Sector

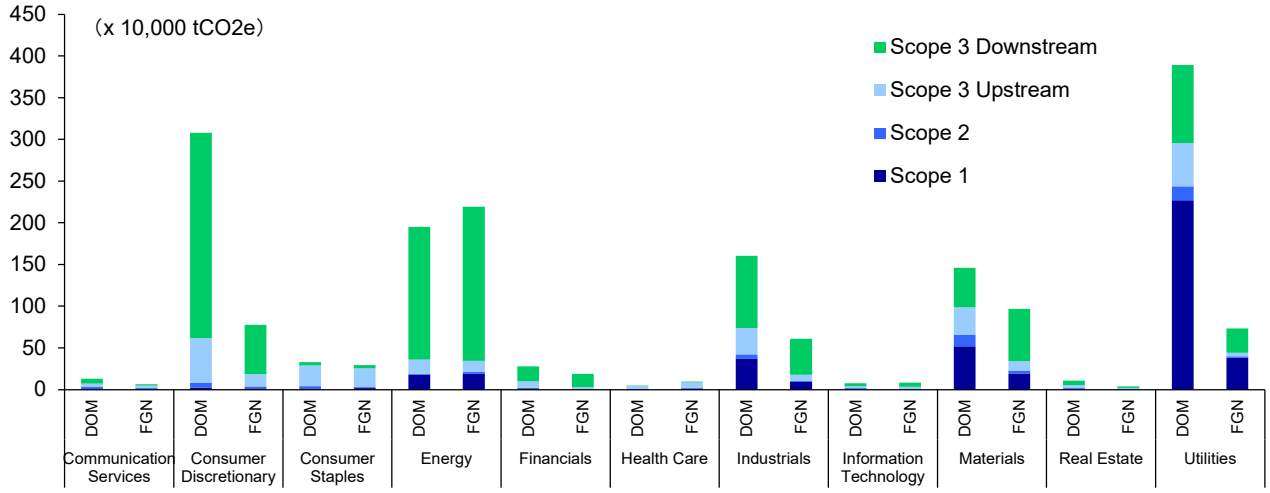
Figure 1-10 shows GHG emissions of the equity and corporate bond portfolios, measured by sector. Domestic equities have larger GHG emissions in "Consumer Discretionary" and "Industrials" than foreign equities, while domestic corporate bonds have larger GHG emissions in "Consumer Discretionary" and "Utilities" than foreign corporate bonds.

Figure 1-10 Greenhouse Gas Emissions by Sector and by Scope

Equity Portfolio



Corporate Bond Portfolio

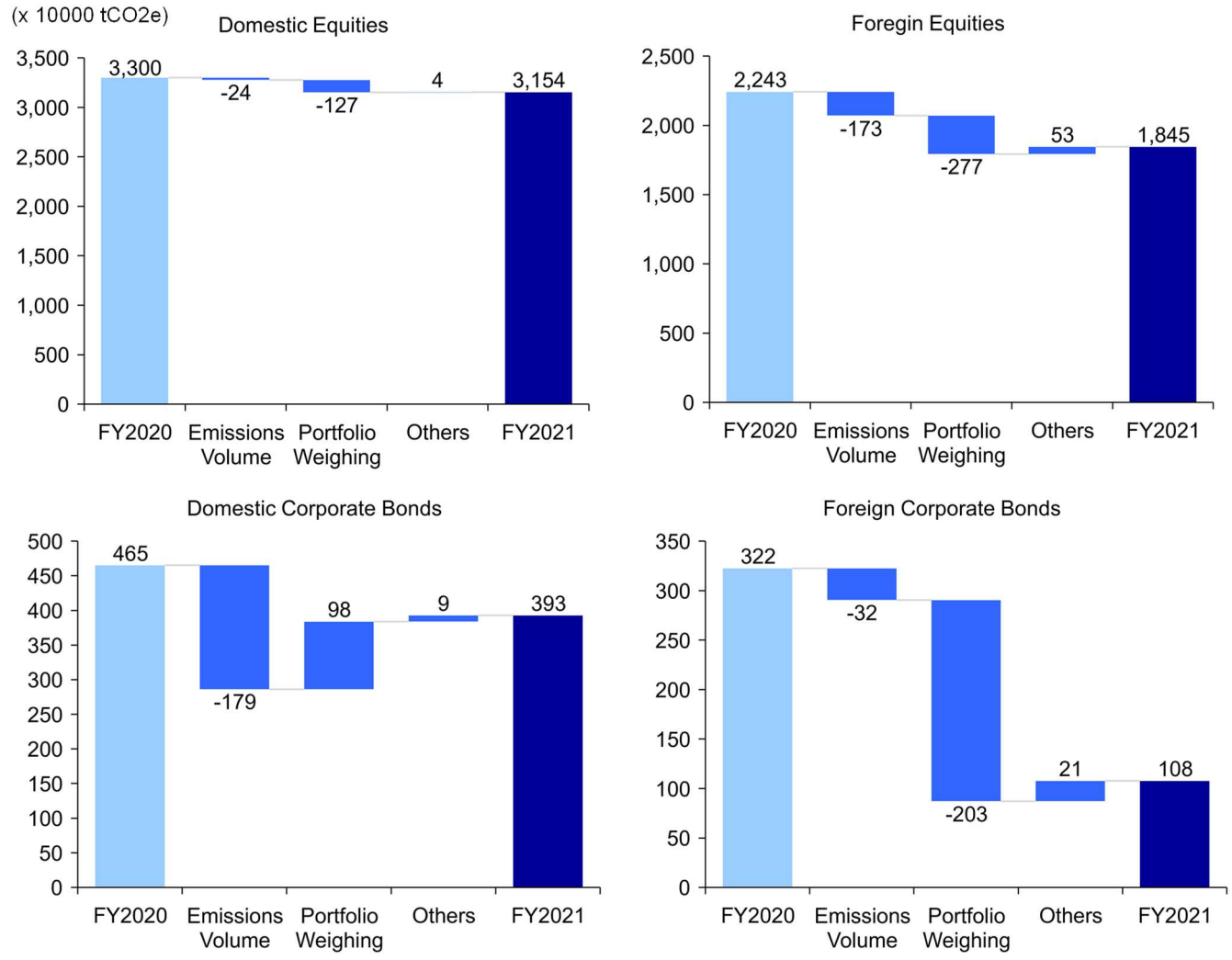


(Note) Data available as of March 31, 2022.
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Performance Drivers of Carbon Footprint Change

Figure 1-11 shows the change in carbon footprint (for Scope 1+2) from FY2020 to FY2021 by asset, and Figure 1-12 shows the change for each asset by sector. The change in carbon footprint is broken down into an "emissions volume factor," which is attributable to changes in the GHG emissions of portfolio companies, a "Portfolio Weighting factor," which is attributable to the percentage of each security holdings in the equity and corporate bond portfolios, and "other factors," factors other than those. The carbon footprint of all assets has decreased over the past year, with the largest negative contribution from the "Portfolio Weighting factor," except for the domestic corporate bonds. In addition, the "Emissions volume factor" was negative for all assets, with the largest negative contribution from "Utilities" by sector (Figure 1-12).

Figure 1-11 Greenhouse Gas Emissions by Scope



(Note) GHG emissons Calculated based on Scope 1+2
(Source) Prepared by GPIF based on data from S&P.
S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Figure 1-12 Breakdown of Carbon Footprint Performance Drivers by Sector (x 10000 tCO2e)

	Domestic Equities						Foreign Equities					
	Emissions FY2021	Emissions FY2020	Emissions Change				Emissions FY2021	Emissions FY2020	Emissions Change			
				Emissions Volume	Portfolio Weighting	Others				Emissions Volume	Portfolio Weighting	Others
Communication Services	32	30	**2**	-1	3	1	18	21	**-2**	1	-3	0
Consumer Discretionary	216	227	**-11**	-14	3	0	53	80	**-27**	-6	-22	1
Consumer Staples	168	168	**0**	-3	2	0	74	79	**-6**	2	-7	0
Energy	164	128	**36**	3	27	5	323	401	**-78**	-44	-57	23
Financials	10	9	**1**	1	1	0	23	32	**-9**	-6	-4	0
Health Care	40	38	**2**	1	1	0	20	21	**-1**	-1	0	0
Industrials	786	684	**102**	2	101	0	122	152	**-30**	-12	-20	1
Information Technology	129	136	**-7**	-13	6	-1	57	63	**-6**	1	-7	0
Materials	1,348	1,382	**-34**	11	-44	-1	658	753	**-95**	-33	-69	7
Real Estate	17	15	**2**	1	1	0	9	13	**-3**	-2	-2	0
Utilities	245	483	**-238**	-12	-227	1	487	627	**-140**	-74	-87	21

	Domestic Corporate Bonds						Foreign Corporate Bonds					
	Emissions FY2021	Emissions FY2020	Emissions Change				Emissions FY2021	Emissions FY2020	Emissions Change			
				Emissions Volume	Portfolio Weighting	Others				Emissions Volume	Portfolio Weighting	Others
Communication Services	3	3	**0**	0	0	0	2	3	**-2**	0	-2	0
Consumer Discretionary	8	5	**3**	0	3	0	4	9	**-5**	-1	-5	1
Consumer Staples	4	4	**0**	0	0	0	3	8	**-5**	0	-5	0
Energy	19	7	**12**	-3	14	1	21	52	**-31**	-5	-29	3
Financials	2	2	**1**	0	0	0	1	1	**0**	0	0	0
Health Care	1	1	**0**	0	0	0	2	3	**0**	0	0	0
Industrials	42	29	**13**	-1	14	0	10	32	**-21**	-10	-17	5
Information Technology	2	1	**0**	0	0	0	1	1	**0**	0	0	0
Materials	66	79	**-13**	0	-13	0	23	89	**-66**	-2	-65	2
Real Estate	2	2	**0**	0	0	0	1	1	**0**	0	0	0
Utilities	244	332	**-88**	-174	78	8	40	123	**-84**	-13	-80	10

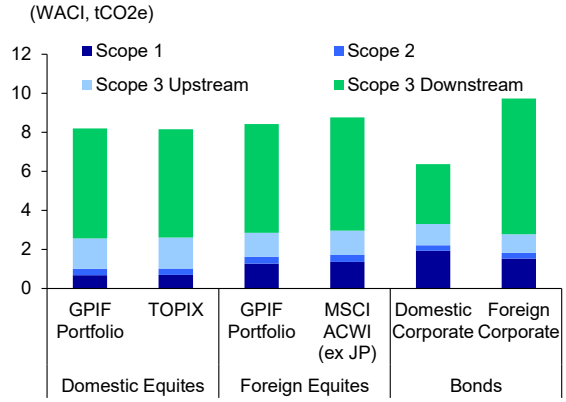
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Carbon Intensity Analysis

Carbon Intensity by Asset

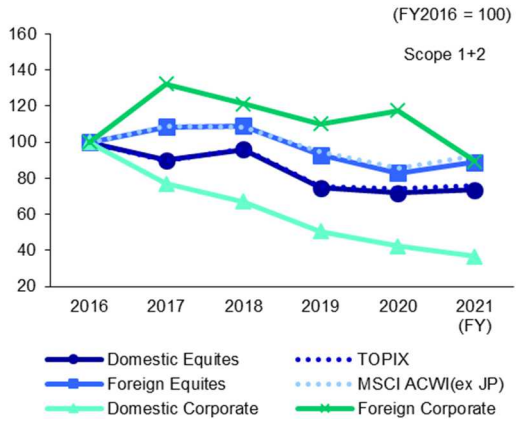
Figure 1-13 shows Scope 1-3 carbon intensity for the equities and bond portfolios at the end of FY2021. For this analysis, weighted average carbon intensity (WACI), the disclosure of which is recommended by the TCFD, was used as the basis for calculation of carbon intensity. WACI is calculated by multiplying each company's GHG emissions per million yen of sales by the company's weighting in the portfolio, then taking the sum of those products to obtain the weighted average of carbon intensity. By asset class, WACI was highest in the foreign bond portfolio, followed by foreign equities and domestic equities at almost the same level, with domestic bonds having the lowest WACI. In all asset classes, Scope 3 accounts for the major proportion of WACI. This is due to the allocations to high-emitting sectors shown in Figure 1-7. The WACI for foreign corporate bonds is much higher than that for domestic corporate bonds. The main reason for this is that, in many sectors, foreign bond issuers tend to have higher carbon intensities than domestic bonds issuers. This trend is particularly noticeable in the energy, financials, and industrials sectors (Figure 1-15). Figure 1-14 shows the trend of WACI, using 100 for combined Scope 1 and 2 emissions in fiscal 2016 as a base. In the five years from fiscal 2016, WACI has generally declined in all asset classes, which is generally in line with the trends in GHG emissions shown in Figure 1-9. In the most recent figures, WACI has risen slightly in the domestic equity and foreign equity portfolios. The reason behind this is of a rise in WACI in the energy and industrial sectors for domestic equities and in the energy sector for foreign equities (Figures 1-16 and 1-17).

Figure 1-13 Weighted Average Carbon Intensity (WACI) by Scope



(Note) Data available as of March 31, 2022.
(Source) Prepared by GPIF based on data from S&P.
S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Figure 1-14 Trends in Weighted Average Carbon Intensity (WACI)



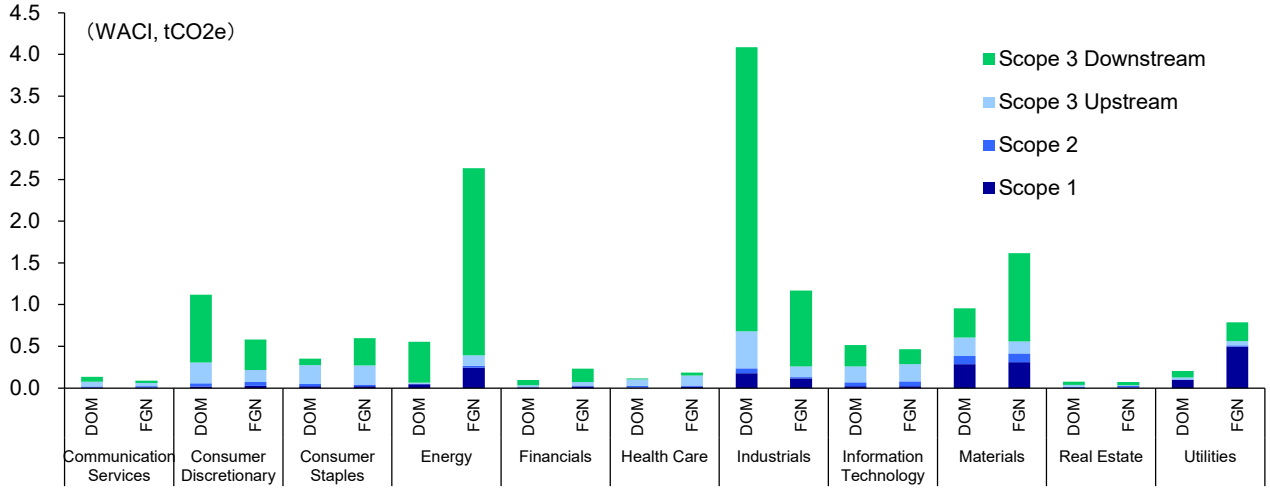
(Source) Prepared by GPIF based on data from S&P.
S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Carbon Intensity by Sector

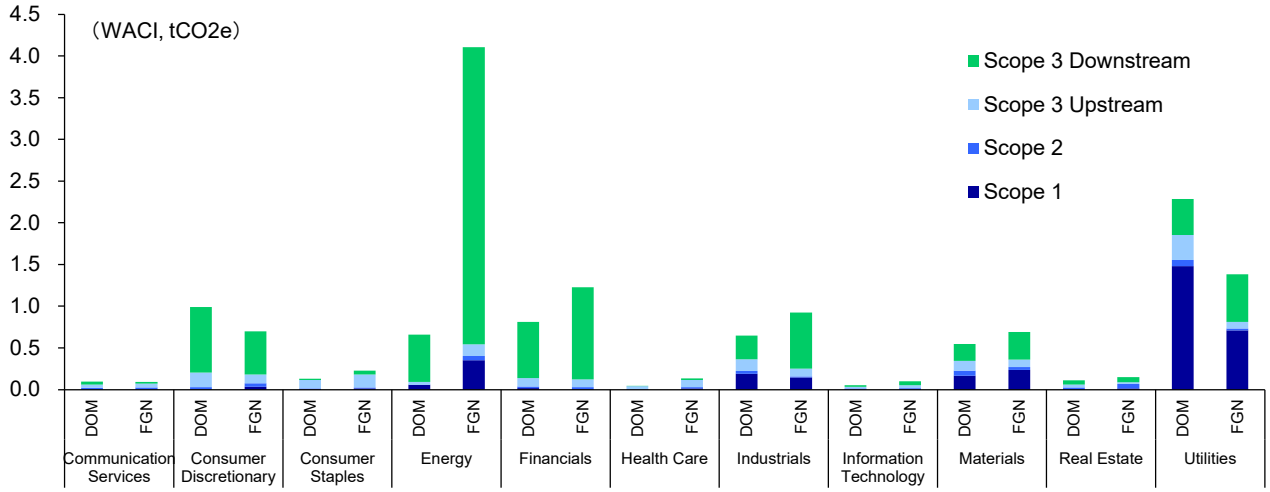
Figure 1-15 shows the weighted average carbon intensity (WACI) of the equity and corporate bond portfolios, measured by sector. Domestic equities have a higher WACI in "Industrials" than foreign equities, and foreign equities have a higher WACI in "Energy" compared to domestic equities. Meanwhile domestic corporate bonds have a higher WACI in "Utilities" than foreign corporate bonds, and foreign corporate bonds have a higher WACI in "Energy" compared to domestic corporate bonds.

Figure 1-15 Weighted Average Carbon Intensity (WACI) by Sector

Equity Portfolio



Corporate Bond Portfolio

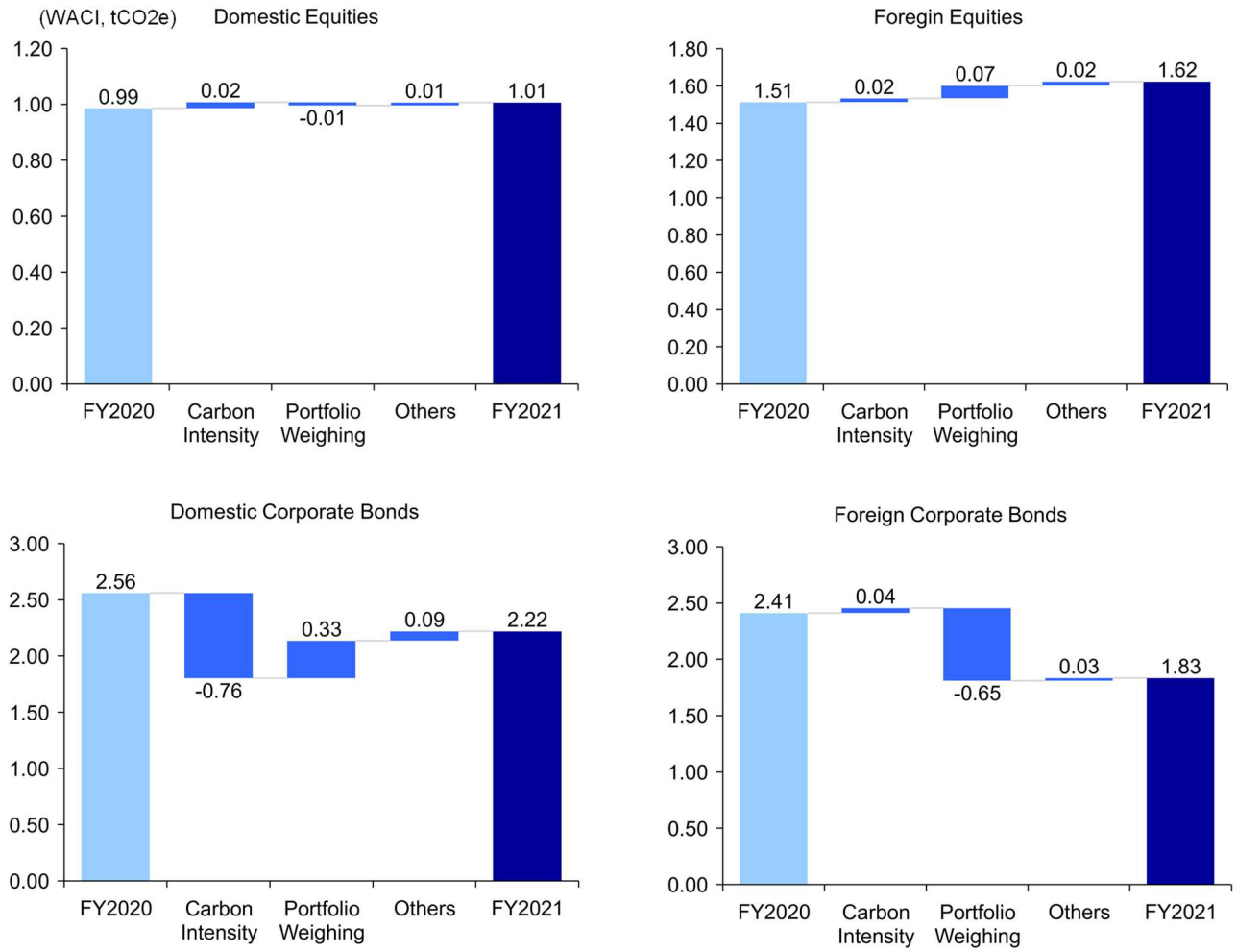


(Note) Data available as of March 31, 2022.
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Performance Drivers of Carbon Intensity Change

The changes in WACI (for Scope 1+2) from FY2020 to FY2021 are shown in Figure 1-16 by asset, and Figure 1-17 by sector for each asset. The WACI changes are broken down into "Carbon Intensity factor," which is attributable to changes in the carbon intensity (GHG emissions/sales) of portfolio companies, "Portfolio Weighting factor," which is attributable to the holding ratio of each company in the portfolio of equities and corporate bonds, and "other factors" which is factors other than those. Over the past year, the WACI for domestic and foreign equities has increased, with "Energy" and "Industrials" being the main contributors to the increase in domestic equities, and "Energy" being the main contributor to the increase in foreign equities. The WACI for domestic corporate bonds and foreign corporate bonds has decreased, with "Utilities" being the main negative contibutor for domestic corporate bonds and "Materials" and "Utilities" for foreign corporate bonds.

Figure 1-16 Breakdown of WACI Performance Drivers by Asset Class



(Note) WACI Calculated based on Scope 1+2
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Figure 1-17 Breakdown of WACI Performance Drivers by Sector (WACI, KgCO2e)

	Domestic Equities						Foreign Equities					
	WACI FY2021	WACI FY2020	WACI Change	Carbon Intensity	Portfolio Weighting	Others	WACI FY2021	WACI FY2020	WACI Change	Carbon Intensity	Portfolio Weighting	Others
Communication Services	18	18	**0**	0	1	0	22	23	**-1**	0	-2	0
Consumer Discretionary	57	57	**-1**	0	-1	0	72	62	**10**	16	-5	-1
Consumer Staples	47	49	**-2**	0	-1	0	42	41	**2**	2	0	0
Energy	48	21	**27**	9	10	8	267	156	**111**	42	52	16
Financials	10	7	**3**	1	1	0	28	26	**2**	-2	4	-1
Health Care	25	26	**-1**	-1	0	0	31	28	**3**	-1	4	0
Industrials	237	186	**51**	5	42	4	131	129	**2**	2	0	-1
Information Technology	68	67	**1**	-4	6	0	79	86	**-7**	-4	-2	0
Materials	382	375	**7**	18	-10	-2	416	407	**9**	9	-7	6
Real Estate	15	12	**4**	0	4	0	24	31	**-6**	-6	1	-1
Utilities	100	168	**-67**	-5	-63	0	513	524	**-11**	-37	22	3

	Domestic Corporate Bonds						Foreign Corporate Bonds					
	WACI FY2021	WACI FY2020	WACI Change	Carbon Intensity	Portfolio Weighting	Others	WACI FY2021	WACI FY2020	WACI Change	Carbon Intensity	Portfolio Weighting	Others
Communication Services	23	21	**2**	0	3	0	25	32	**-7**	-1	-8	1
Consumer Discretionary	30	20	**10**	0	10	-1	75	75	**0**	26	-22	-4
Consumer Staples	16	23	**-7**	-1	-6	0	24	35	**-11**	1	-12	0
Energy	58	56	**2**	-20	19	3	404	410	**-7**	55	-58	-3
Financials	37	30	**7**	4	5	-1	29	20	**9**	1	8	0
Health Care	8	8	**0**	0	0	0	31	25	**5**	-1	7	0
Industrials	225	168	**58**	-9	65	1	159	172	**-13**	27	-30	-11
Information Technology	15	13	**2**	-1	2	0	17	18	**-1**	-1	0	0
Materials	226	280	**-53**	12	-61	-4	271	527	**-256**	13	-271	2
Real Estate	27	47	**-21**	2	-22	-1	68	55	**14**	-10	25	-1
Utilities	1,556	1,896	**-340**	-747	319	87	733	1,041	**-309**	-66	-285	42

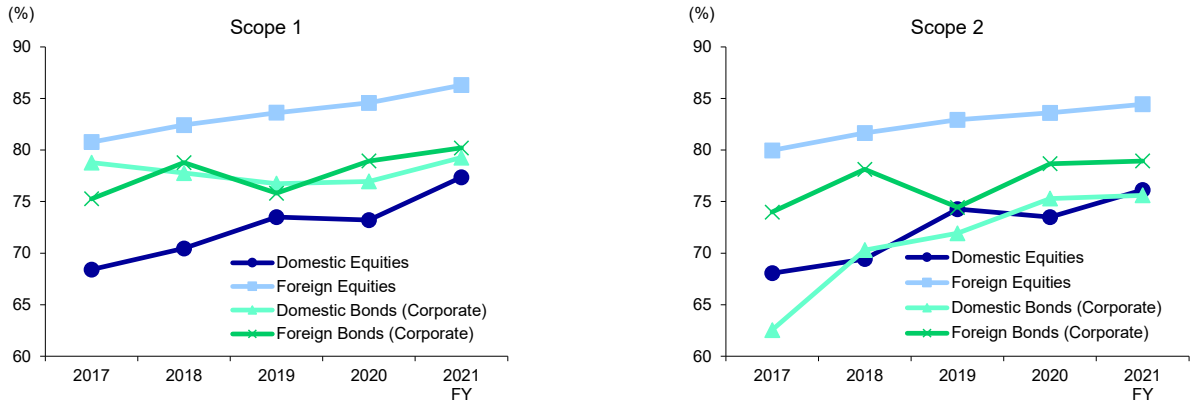
(Note) WACI Calculated based on Scope 1+2
(Note) Domestic and foreign equities are shaded for sectors contributing to the main increase in WACI, while domestic corporate bonds and foreign corporate bonds are shaded for sectors contributing to the main decrease in WACI.
(Source) Prepared by GPIF based on data from S&P. S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Corporate Disclosure of GHG Emissions

Status of Disclosure Ratio by Scope

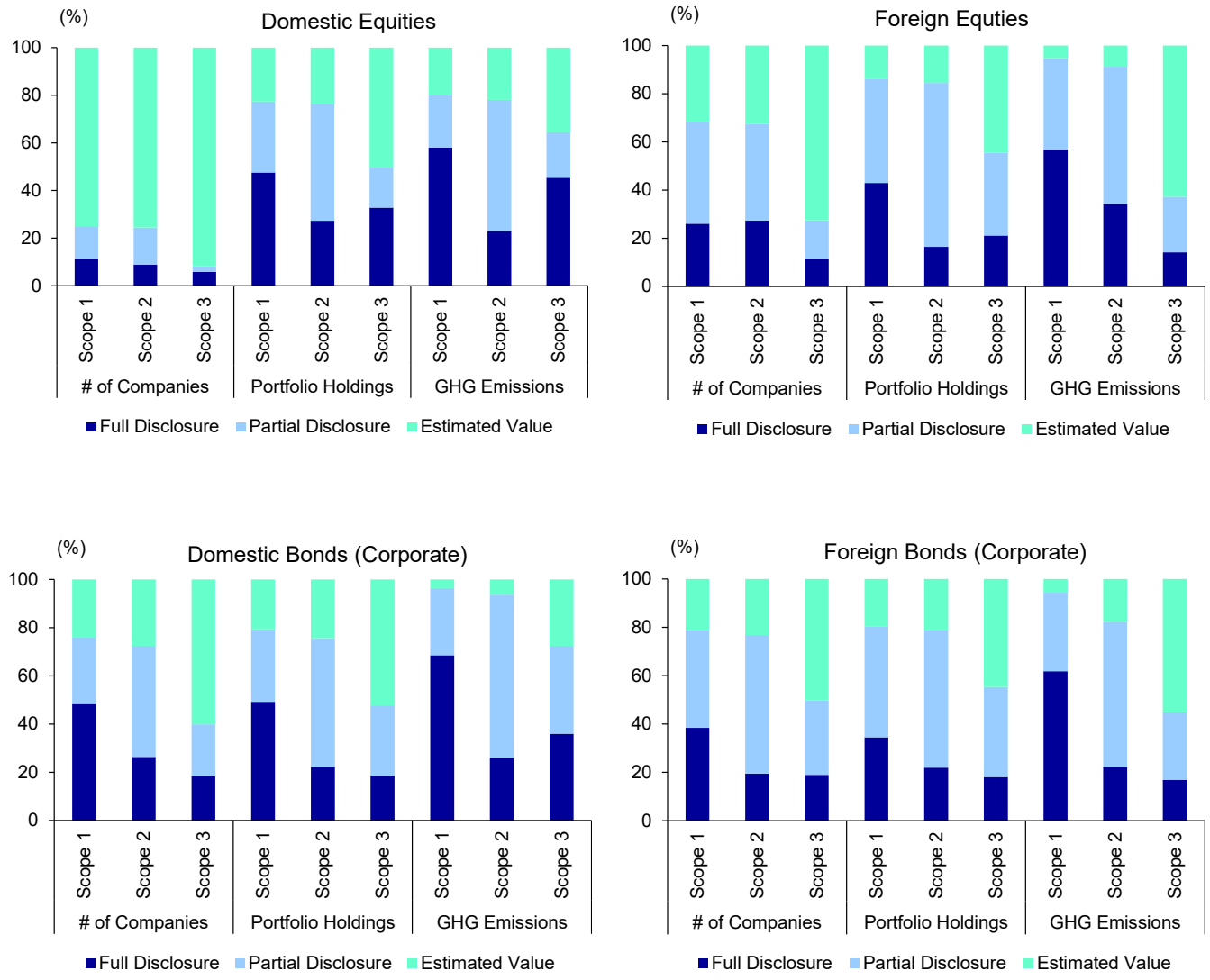
Figure 1-18 shows the change in status of corporate disclosure of GHG emissions in the equity and corporate bond portfolios since FY2017, and Figure 1-19 shows the status of disclosure as of the end of FY2021 by Scope 1 through Scope 3. For Scope 3 in Figure 1-19, our analysis only covers the downstream Scope 3. The reason for this is that the Trucost GHG emissions data used in the analysis for upstream Scope 3 are model estimates for all categories other than air, rail, and truck transportation. We also checked the disclosure ratios for each asset in terms of three categories: disclosure ratios based on the number of companies, disclosure ratios weighted by the amount of portfolio holdings, and disclosure ratios weighted by the amount of GHG emissions. Figure 1-18 shows that the disclosure ratios (including partial disclosure) for both Scope 1 and Scope 2 are on the rise for all assets, but the disclosure ratios for domestic assets remain low compared to foreign assets. Figure 1-18 shows that for all assets, the disclosure ratios in terms of the number of companies are generally lower than the ratios weighted by the amount of GHG emissions and the ratios weighted by the amount of GHG emissions, for both full disclosure and partial disclosure combined. This trend is particularly noticeable in Scope 3 for domestic and foreign equities. This may be due to the fact that larger companies and companies with higher GHG emissions are more likely making progress in disclosing information. In addition, for all assets, the disclosure ratio weighted by the amount of GHG emissions shows a higher ratio of Scope 1 full disclosures compared to the disclosure ratio weighted by the amount of portfolio holdings. This suggests that companies with larger GHG emissions are more likely making progress in disclosing information on their direct emissions.

Figure 1-18 Change in Disclosure Ratio Weighted by Portfolio Holdings



(Note) Disclosure includes "partial disclosure".
(Source) Prepared by GPIF based on data from S&P.
S&P Global Sustainable1, S&P Trucost Limited ©Trucost2022

Figure 1-19 Disclosure of GHG emissions by Companies



(Note) Scope 3 covers only downstream Scope 3.
(Note) Data available as of March 31, 2022.
(Source) Compiled by GPIF based on data provided by S&P
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Chapter 2: Public- and Private- Sector Support for Achieving a Net-Zero Economy

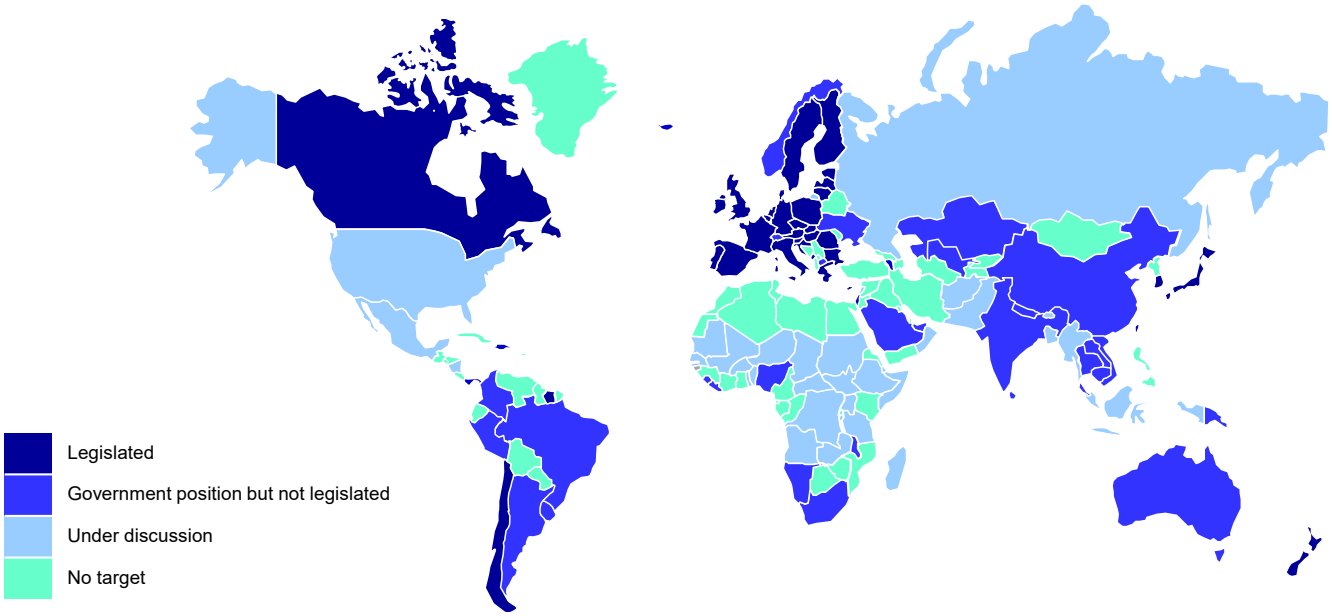
Global Decarbonization Policy Trends

Decarbonization Policy Trends

In the previous sections, the carbon footprint of GPIF portfolio, which affected by GHG emissions from countries and companies, was analyzed. In this section, climate policies of countries and decarbonization targets set by companies were assessed. The analysis conducted by BloombergNEF (BNEF) would present major structural changes in the future towards net zero.

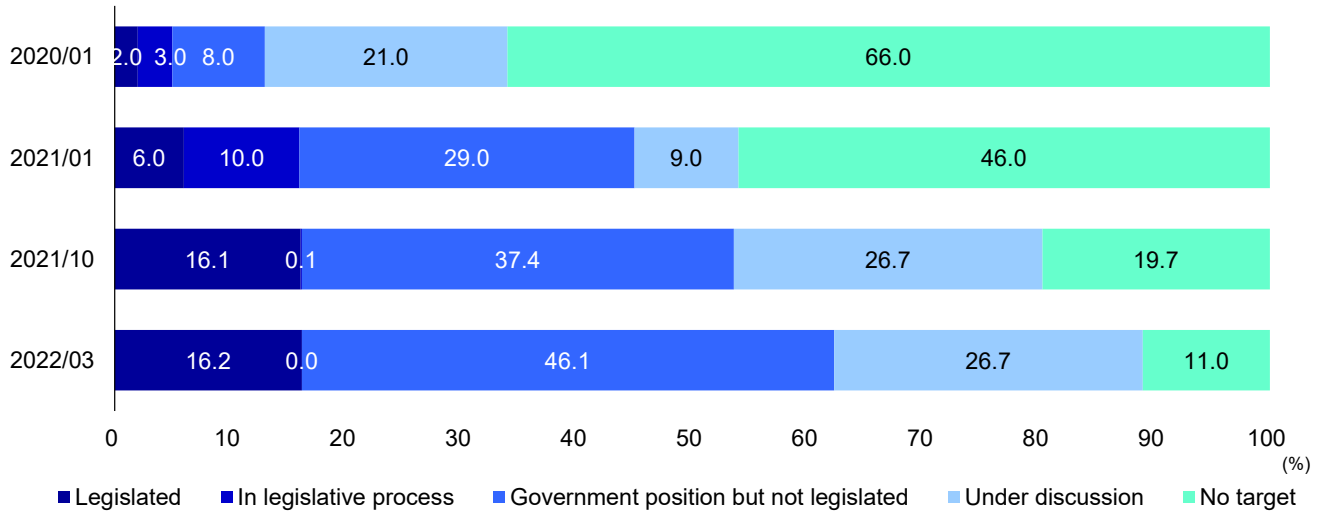
At COP26 in 2021, “pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels” was included in the Glasgow Climate Pact. Moves toward net zero in the lead-up to COP26 could be seen from 2019. Chair nation, United Kingdom, started the ball rolling by legislating its net zero targets, and since then, many countries, including the various European nations, China, and Japan have been pursuing decarbonization initiatives aimed at net zero by 2050 to 2060. According to BNEF data, more and more countries are declaring their own net zero targets, with 88 countries having committed (already legislated or in government position) to net zero as of March 2022 (Figure 2-1). The ways to declare net zero vary, with only 17.6% of countries, including the European nations and Japan, having legislated their targets. Most countries are still at the pre-legislation stage of government commitment (28.0%) or have just started discussing legislation (30.1%). Taking global GHG emissions in 2019 as the total, 89% of total emissions as of March 2022 are subject to commitment or preparations for commitment. This is a significant progress since 2020 (Figure 2-2).

Figure 2-1 Countries with Net Zero Targets (As of March 2022)



(Source) BloombergNEF

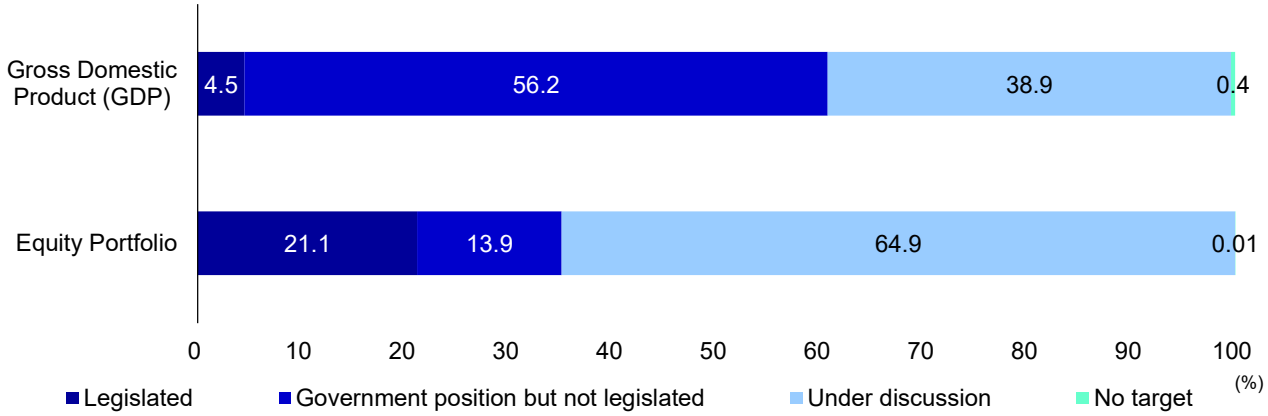
Figure 2-2 Share of Global GHG Emissions Covered by a Net Zero Policy



(Note) Based on GHG emissions in 2019 as the total.
(Source) BloombergNEF

In terms of the commitment coverage rate based on gross domestic product (GDP), 99.6% of global GDP is covered by net zero commitments or preparations currently in progress. In addition to GDP, analysis of the commitment coverage rate based on GPIF's equities portfolio found that coverage was 99.9%, based on the countries to which the markets where GPIF's holdings are listed belong (Figure 2-3). While coverage on a GHG emissions basis is just under 90%, on the basis of GDP and GPIF's equities portfolio, more than 99% is headed toward net zero. As the world moves toward 2030 and 2050 targets, individual countries are expected to mobilize fiscal and monetary policies alongside environmental regulations. GPIF believes that, as a global investor that invests in almost all the equities and bonds that are out in the market, it is crucial that we have an accurate understanding of the major changes in those policies for us to steer our portfolio in the appropriate direction.

Figure 2-3 Coverage of Carbon Neutrality Commitments (GDP and GPIF Equities Portfolio)



(Note) Weighted averages of GDP (2019) and GPIF portfolio constituent stocks (as of March 31, 2022) have been calculated according to GHG emissions by country.
(Source) BloombergNEF

Visualization of the Impacts of Net Zero Policies

To understand developments in global net zero policies, we analyzed individual countries' net zero targets using BNEF's Zero Carbon Policy Scoreboard.

The policies announced by each country are evaluated according to 130 metrics under the three themes of policies' (1) presence, (2) robustness, and (3) effectiveness. In terms of policy presence, BNEF analyzes what kind of policies are being implemented in six major areas, namely power, low-carbon fuels and CCUS, transport, buildings, industry, and the circular economy. At the same time, the ambition and stringency of each policy are also analyzed. Given that net zero policies affect many industries, their robustness is also evaluated using metrics of transparency (such as a government publishing details about a policy on a public website, including description, status, method of implementation, etc.) and stringency of targets. Finally, the effect of policies when implemented is evaluated using "policy effectiveness" indicators (Figure 2-4).

Figure 2-4 Zero-Carbon Policy Scoreboard Methodology

(1) 6 sectors and policy types used to assess policy presence

Points	Power	Low-carbon fuels & CCUS	Transport	Buildings	Industry	Circular economy
1	Renewables tax incentives or grant/loan program	Roadmap/strategy/ plan for green gas or CCS	EV incentives for recurring taxes (eg, road tax)	Energy efficiency grants/loans or plan	Energy efficiency incentives or circular economy standards on end-products	MSW recycling target or extended producer responsibility scheme
2	Renewables or emission target on power sector	Grant/loan program or voluntary traded certificates for traceability	EV deployment target or one-off taxes (eg, VAT, import duties)	Building heat decarbonization target or roadmap	Renewable heat target or emission target on industrial heat (or industry)	Limit on single-use plastics
3	Renewables feed-in tariff or premium, tax credits or incentive for small-scale renewables generation	Incentives for carbon capture	EV purchase subsidies	Operating cost subsidies on low-carbon heating or efficient cooling technologies	Operating cost subsidies on electrification or renewables technologies	Fees or recycling targets for packaging
4	Renewables auction program or RPS/REC scheme	Blending mandate or demand-side policies, or quantitative target for green gas consumption or production	EV charging support	Heat-pump tax credits or grants/loans, boiler scrappage scheme, district heat subsidies or CO2 price	Upfront cost subsidies on electrification, renew-ables technologies or obligation/mandate	Pay-as-you-throw schemes
5	Financial incentive, tax credit or regulatory program for low-carbon flexible resources	Support for infrastructure rollout	Fuel economy standards or emission targets on transport, or ICE ban	Energy performance standards or boiler ban for new homes	Carbon pricing or fossil-fuel ban for industrial heat (or biggest subsectors)	Is the EPR mentioned in level 2 eco-modulated (ie, material specific)?
6	Carbon price on electricity, or ban on coal, gas or oil-fired power generation	Incentives for carbon utilization	Carbon price on transport	Energy performance standards or boiler ban for all homes	Obligatory standards or mandates on products or companies	Recycled content laws

(2) Factors used to evaluate policy robustness

Factor	Minimum = 0 points	Maximum = 6 points
Transparency of information about policies and policy-making process	It is impossible to know what government policies and regulations are in place in a given sector, and no clear method of contacting the relevant government body. If you're lucky, there is a newspaper article on a proposed policy but you have no clear way to find out how it will be passed and implemented, and what stage it has reached. No stakeholder consultation on changes, which are not communicated clearly to the public.	Government publishes on a public website details about policies including description, status, method of implementation, etc. For proposed policies, you can easily find our which legislative/regulatory process applies and the status of the proposal. Forthcoming changes are well-publicized in advance, stakeholder consultations are held to get public comment and they are communicated clearly to the public. Website has a clear way to contact the relevant government body.
Predictability of the policy-making process	Policies and regulations are changed frequently, with no clear, established method for amendments. Essentially you can't be sure that a policy will remain in place, in its current form, for the foreseeable future. At worst, the government/regulator makes retroactive changes, notably changes that reduce potential revenue or other upside from a project or investment.	You can be relatively sure of a policy or regulation's stability over the foreseeable future. If changes are proposed, then they are relatively infrequent, follow a clear established process and are not retroactive.
Completeness of policy mix	The question here is whether the country has enough policy support to reach net-zero emissions in this sector. A truly awful country might have no policies in a given sector, or might only have one policy targeted at one technology/area. The completeness relates to both to the decarbonization pathways and solutions, and types of policy support in place.	The question here is whether the country has enough policy support to reach net-zero emissions in this sector. In a given sector, government has implemented support to incentivize a range of technologies or practices using a range of policy types (carrots and sticks).
Stringency and achievability	Sector or technology targets and regulations are set so low or at such weak levels that the country needs to make little effort to achieve them and/or they would not put the country on track to reach net-zero by mid-century.	Sector or technology targets would require substantive but not unrealistic effort to be achieved. They put the country on track to reach net-zero by mid-century.

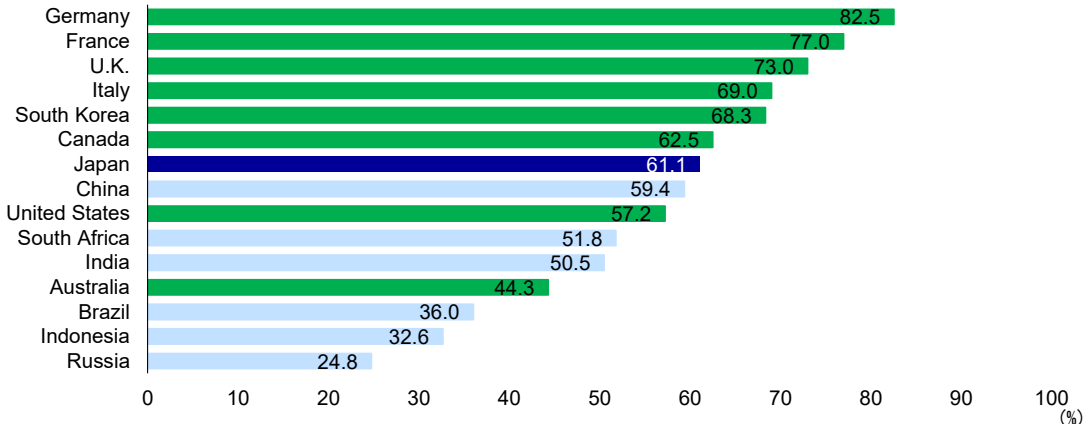
(3) Factors used to evaluate policy effectiveness

Factor	Minimum = 0 points	Maximum = 6 points
Effectiveness of policies	The policies seem to have had no impact on the market in practice. And this lack of effectiveness cannot be attributed to outside factors - eg, the pandemic.	The policies have had, or at least begun to have, a noticeable effect on the market.

(Source) GPIF, BloombergNEF

A ranking of scores obtained with the above methods puts the European countries of Germany, France, U.K. and Italy at the top, with Japan, China and the United States ranking in the middle of the pack (Figure 2-5).

Figure 2-5 Zero Carbon Policy Scores of Major Countries



(Note) Carbon policy scores are given to countries belongs to the G20. Green indicates developed countries, while blue indicates developing countries.
(Source) GPIF, BloombergNEF

Next, when the breakdown of those scores is evaluated, Germany scored well for its introduction of a renewable energies auction program, the announcement of a proposal to phase out coal-fired power generation, and the introduction of a domestic emissions trading scheme, taking out first place in four areas - power, low carbon fuels and CCUS, buildings, and industry. Japan was assessed as being less ambitious in its targets than the top-scoring countries. Specifically, in transport, the low target for EVs' share of new passenger car sales in 2030, and in power, its inability to give a clear indication regarding the phase out of coal-fired power generation appear to have led to Japan's low scores. On the other hand, due to Japan's small land area, its industrial waste taxes are relatively high, and per-capita municipal waste generation is low, making it one of the best performers in the circular economy area (Figure 2-6).

Figure 2-6 Comparison of Zero Carbon Policy Scores by Theme

	Power	Low-carbon fuels & CCUS	Transport	Buildings	Industry	Circular economy
Germany	**84%**	**75%**	88%	**81%**	**78%**	65%
France	76%	60%	**89%**	73%	69%	67%
U.K.	83%	71%	77%	56%	72%	67%
Italy	73%	43%	84%	71%	58%	64%
South Korea	73%	55%	70%	62%	63%	**70%**
Canada	67%	63%	68%	47%	54%	39%
Japan	62%	55%	62%	68%	56%	69%
China	67%	43%	75%	53%	52%	28%
United States	59%	69%	63%	45%	38%	33%
South Africa	67%	23%	29%	32%	39%	34%
India	60%	37%	58%	41%	42%	35%
Australia	53%	35%	33%	50%	44%	40%
Brazil	56%	50%	33%	30%	23%	38%
Indonesia	32%	33%	33%	32%	32%	35%
Russia	36%	16%	22%	18%	19%	33%

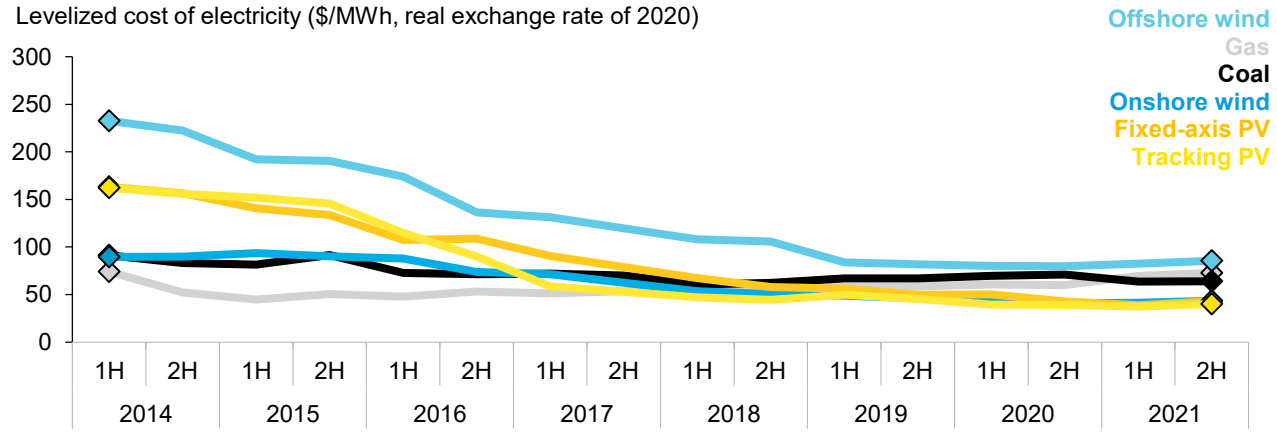
(Source) GPIF, BloombergNEF

Global Decarbonization Technologies Investment Trends

Decarbonization Technologies Investment Trends

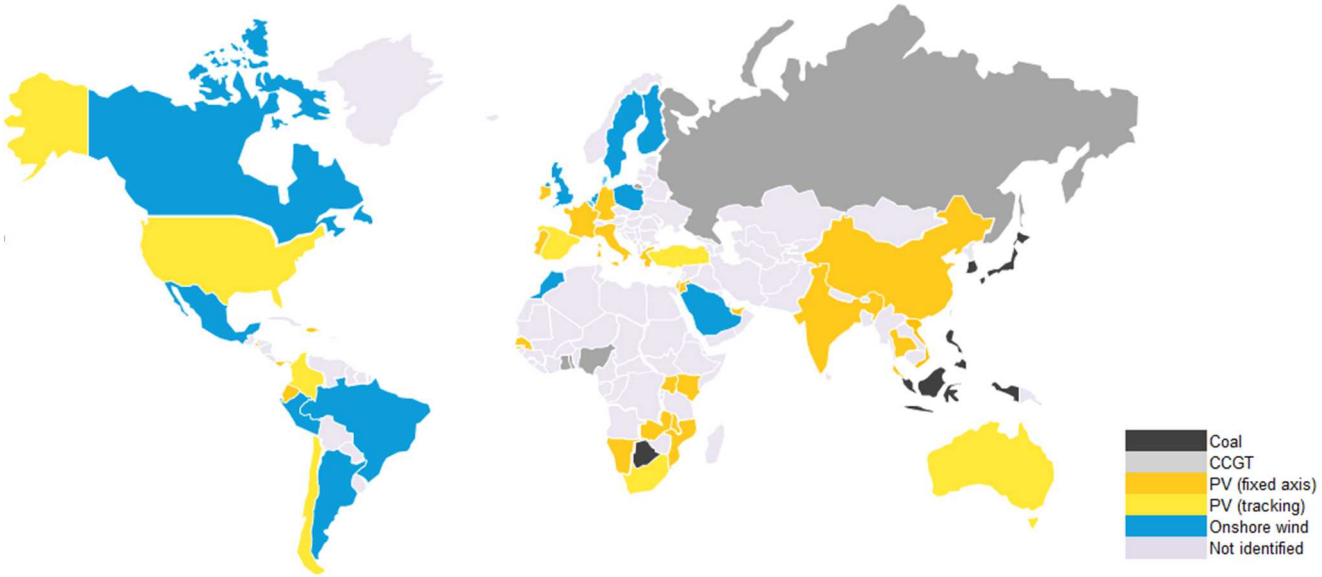
To achieve net zero, a transition to low carbon-intensity business models will be needed in a wide range of industries. This will require the large-scale deployment of decarbonization technologies. Among such technologies, there are examples like solar and wind power generation, where prices have fallen thanks to technological progress and that are already starting to replace conventional technologies. As shown in Figure 2-7, the cost per MWh of electricity generated by onshore wind has fallen by 52% since 2014. For offshore wind and utility-scale solar (Fixed-axis PV and tracking PV), the cost has fallen by 62% and 74%, respectively. According to BNEF analysis, today, two-thirds of the global population lives in a country where either onshore wind or utility-scale PV is the cheapest new bulk electricity generation (Figure 2-8). This set of countries also accounts for about 77% of global GDP. Compared to data from 2014 (Figure 2-9), while either onshore wind or utility-scale PV has become the cheapest source of bulk electricity generation for new build projects in many countries, coal remains the cheapest bulk generation source for a limited number of countries like Japan.

Figure 2-7 Global Levelized Cost of Electricity (LCOE) Benchmarks



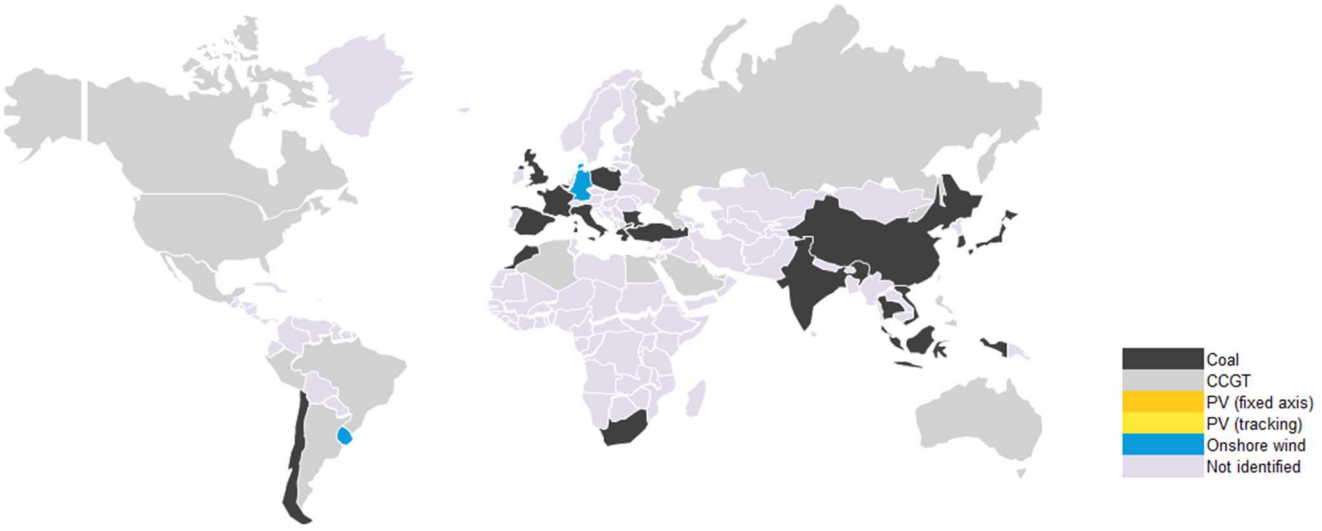
(Source) BloombergNEF

Figure 2-8 Cheapest Source of Bulk Generation, 2H 2021



(Source) BloombergNEF

Figure 2-9 Cheapest Source of Bulk Generation, 2014

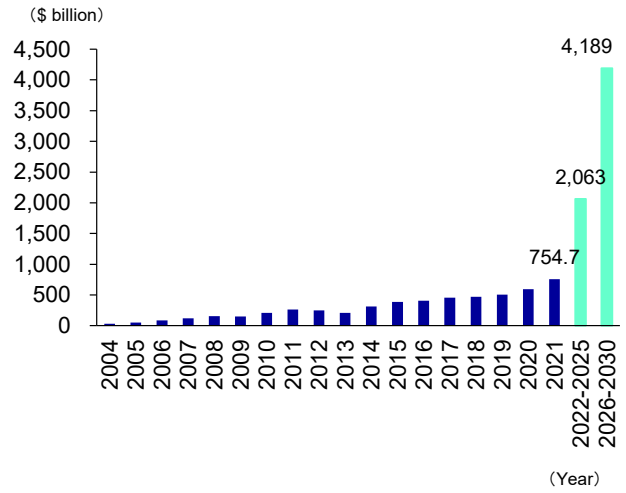


(Source) BloombergNEF

However, the deployment of large-scale decarbonization technologies will require enormous amounts of investment. According to BNEF analysis, $755 billion was invested in energy transition in 2021 (Figure 2-10). This accounts for 0.84% of the world's GDP in 2021, and investment is consistently breaking new records at a growth rate of 10% a year. Investment in China, in particular, grew to $285.5 billion in 2021, representing an increase of more than 60% over 2020. (Figure 2-11). With China leading the way, new record highs are being achieved in investments in the areas of renewable energy and electric vehicles (Figure 2-11).

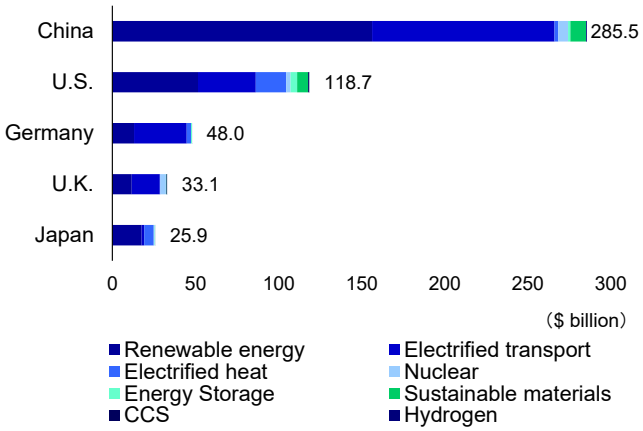
According to the International Energy Agency (IEA), global investments in clean energy will need to reach approximately $4 trillion a year, three times current levels, by 2030 if carbon neutrality is to be achieved in 2050. A further rapid growth in investment in these areas can be expected.

Figure 2-10 Decarbonization Technologies Investment[1] Trends



(Note) Amounts for 2022-2025 and 2026-2030 are the averages of estimates based on the three scenarios in BloombergNEF's New Energy Outlook (NEO). Investment amounts shows the total investments represented in Figure 2-11.
(Source) GPIF, BloombergNEF

Figure 2-11 Investment Amounts in Decarbonization Technologies in 2021 (by Country and Technology)

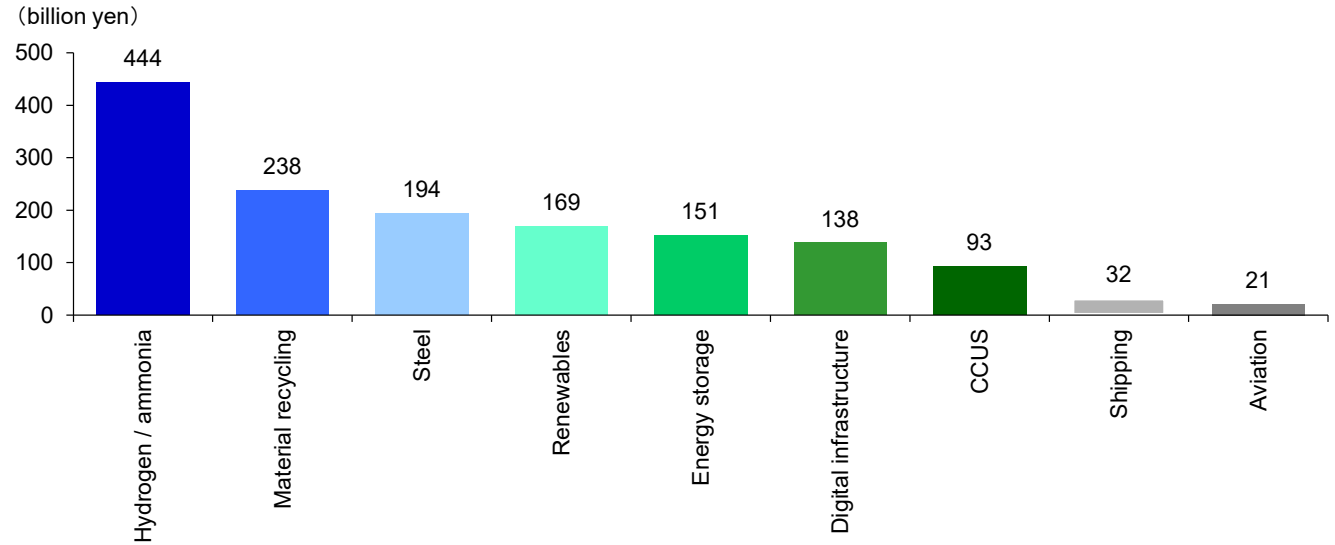


(Note) Investment amounts in 2021
(Source) GPIF, BloombergNEF

[1] Capital investment by private-sector and government subsidies (total of amounts granted)

Japan currently appears to be lagging somewhat behind, but in June 2021, the "Green Growth Strategy" was released to support the development of key technologies to achieve net zero emissions, such as energy storage or carbon recycling. This has created a structure that facilitates funding for the development of low-carbon technologies, generating expectations for further advances. The Japanese government, as part of the Green Growth Strategy, has created a 2 trillion yen Green Innovation Fund to support companies developing key decarbonization technologies and has announced that as of June 2022, a total of 1.5 trillion yen worth of funding will be provided for specific projects (Figure 2-12).

Figure 2-12 Green Innovation Fund Allocation by Technology, as of June 2022

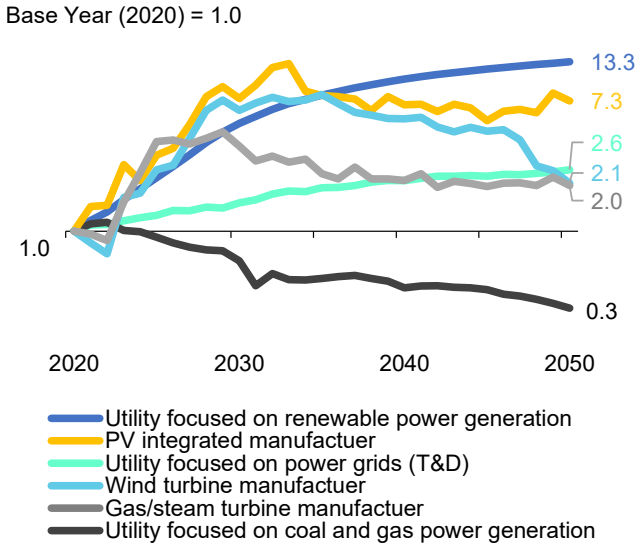


(Source) GPIF, BloombergNEF

In this part, revenue data from business activities in 2020 is used to analyze the impacts of global demand for decarbonization technologies on company revenues, using market growth rate forecasts in each business segment until 2050. The change in revenue of businesses with high carbon intensity and those with low carbon intensity in the power and transport sectors show that, in both sectors, companies with large exposure to high carbon-intensive activities will experience a reduction in revenues (Figures 2-13 and 2-14).

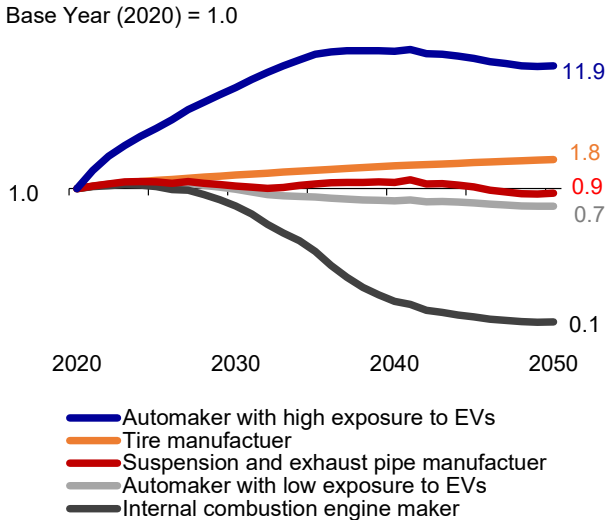
As shown in Figures 2-13 and 2-14, in the larger transition toward decarbonization, companies that are unable to adapt will be left behind and may become less competitive due to regulations. Declaring a decarbonization target is a major step forward, but the next requirement is concrete action, such as active investments towards transition.

Figure 2-13 Outlook of Revenue Structure Changes for Representative Companies in the Power Sector



(Note) Based on Green Scenario in BloombergNEF's New Energy Outlook (NEO).
(Source) BloombergNEF

Figure 2-14 Outlook of Revenue Structure Changes for Representative Companies in the Transport Sector



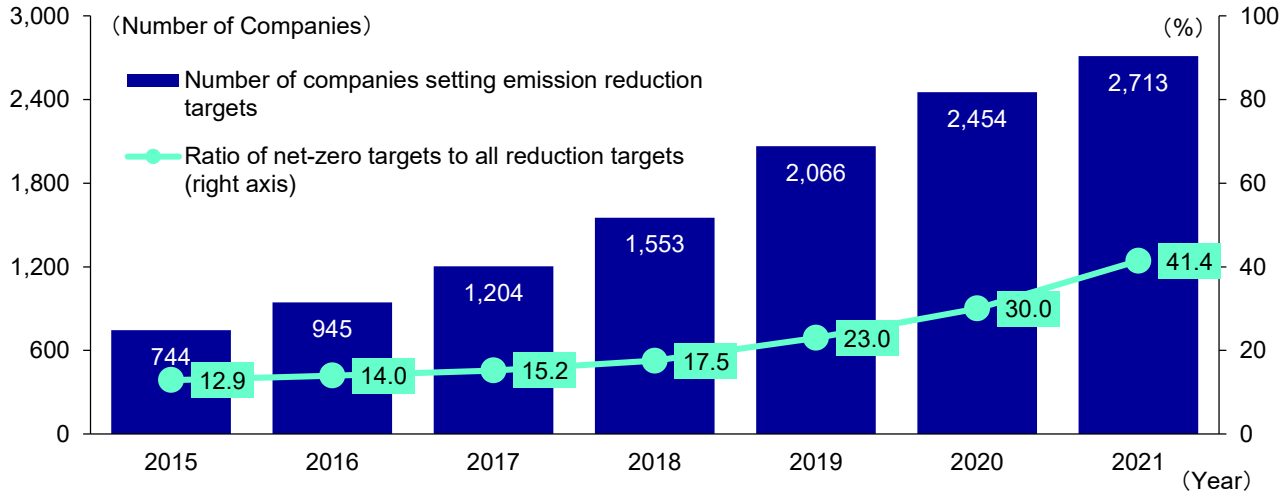
(Note) Based on Net Zero Scenario in BloombergNEF's New Energy Outlook (NEO).
(Source) BloombergNEF

Status of Companies' Setting of Greenhouse Gas Emission Reduction Targets

Analysis of Companies' Setting of Greenhouse Gas Emission Reduction Targets

Carbon neutrality will not be achieved by national governments alone; it requires the combined efforts of government and the private sector. The following section examines the status of setting of GHG emissions reduction targets by companies. Among the companies in the MSCI ACWI Investable Market Index (IMI), an equity index having the world's main equities as constituents, the number of companies setting GHG emissions reduction targets has been growing since 2015 (Figure 2-15). As of the end of 2021, 2,713 of the total 9,220 constituents, or 29.4%, had set some kind of reduction target. More companies are also setting long-term targets for net zero, accounting for 41.4% of new targets set in 2021.

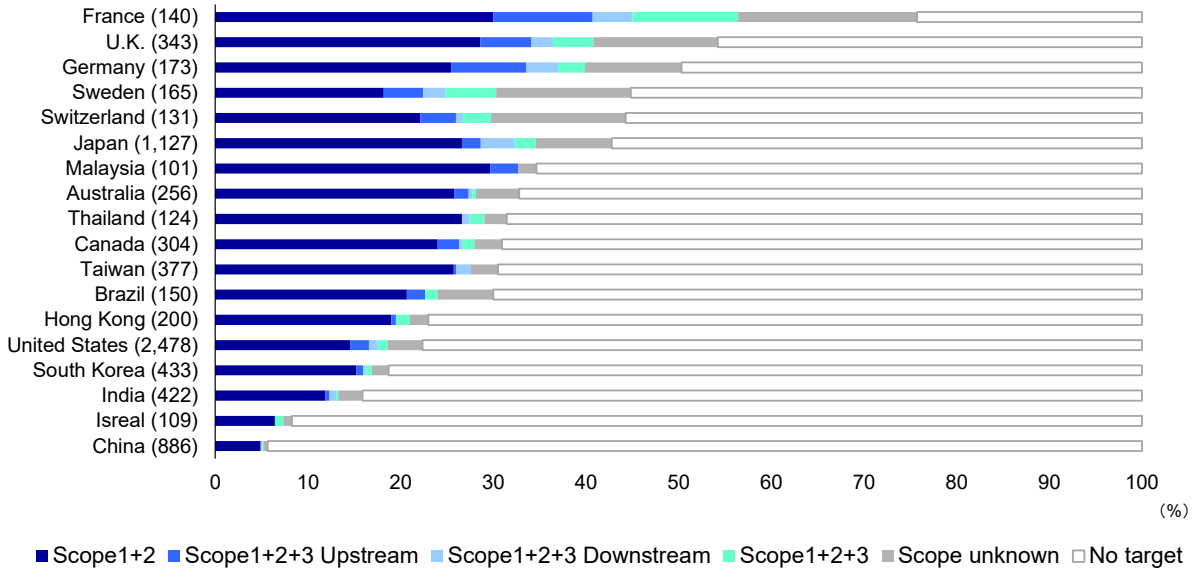
Figure 2-15 Number of Companies with GHG Emissions Reduction Targets and Rate of Net Zero Targets to All Reduction Targets



(Note) The rate of net zero targets to all reduction targets is calculated from new targets set each year by MSCI ACWI IMI constituents.
(Source) Reproduced by permission of MSCI ESG Research LLC ©2022

When the status of corporate reduction targets among companies in the MSCI ACWI IMI is examined by country, we find that many companies in the European countries that topped the Carbon Policy Scoreboard[1], namely France, the U.K. and Germany, have set targets (Figure 2-16). A trend can also be seen with developed countries having a higher percentage of companies setting decarbonization targets.

Figure 2-16 Status of GHG Emissions Reduction Targets by Constituent Companies of MSCI ACWI IMI (By Country)



(Note) Covers 9,179 stocks with data in the MSCI ACWI IMI. Countries with at least 100 eligible companies (26 developed countries, 30 emerging countries) are shown on the graph. Figures in brackets are the number of companies in that country.
(Source) Reproduced by permission of MSCI ESG Research LLC ©2022

In this section, the existence of companies' greenhouse gas emissions targets (GHG reduction targets) and the coverage rate of companies' GHG reduction targets to GHG emissions ("emissions coverage rate") is analyzed using MSCI's Target Score Card.

The analysis examined individual companies that constitute indexes in three regions, namely Japan (MSCI Japan IMI), developed markets (MSCI Kokusai IMI), and emerging markets (MSCI EM IMI).

For the aggregating of data, based on the GHG emissions of individual companies, data for each scope (1) was calculated, and GHG emissions reduction target data (2) for each company was totaled. The extent of the scopes targeted in disclosures were confirmed and, based on (1) and (2), the emissions coverage rate (3) was calculated. The data in (1) to (3) has been added up by sector for each index.

The results show that, for both Japanese companies and companies in developed markets included in MSCI Kokusai IMI (developed-market companies) and companies in emerging markets included in

[1] For details, see " Visualization of the Impacts of Net Zero Policies" on page 26.

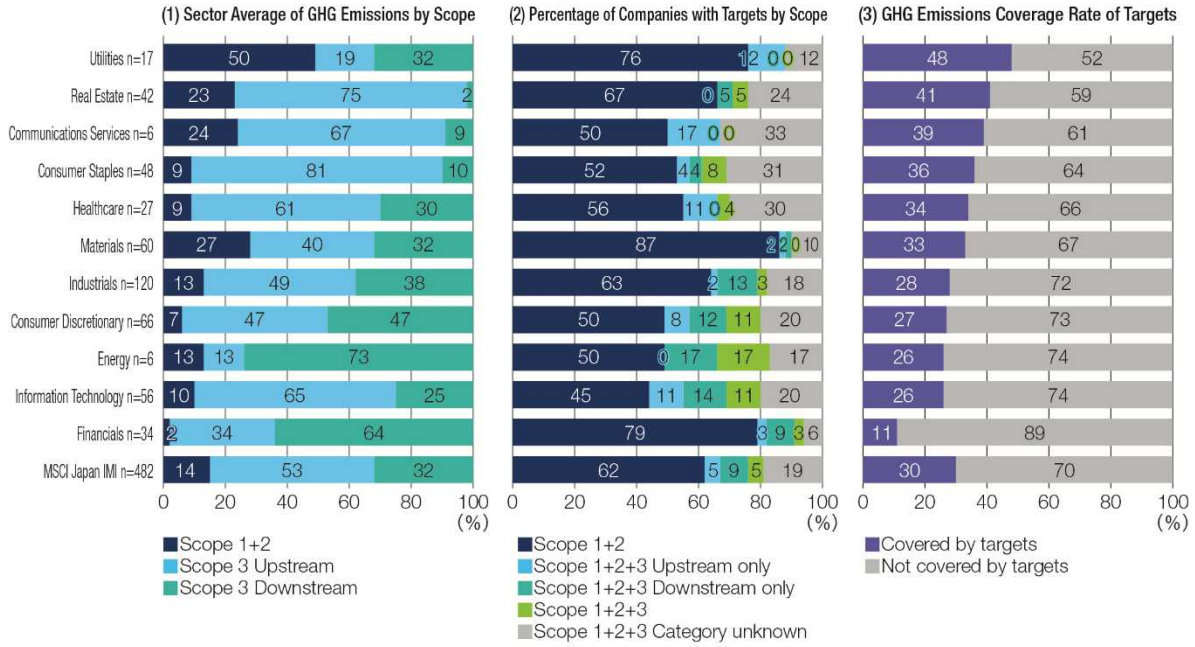
MSCI EM IMI (emerging market companies), emissions coverage rate was highest in the utilities sector. In all three regions, the financial sector had the lowest or second lowest emissions coverage rate, indicating a common trend.

On the other hand, there were also some distinctive differences. First, the second highest emissions coverage rate among Japanese companies was in the real estate sector, whereas it was in the materials sector for the developed-market companies and emerging-market companies. Emissions coverage in the healthcare sector was toward the top for Japanese companies and emerging market companies but low for developed-market companies.

One likely factor behind these variations in emissions coverage rates is that, even though the proportion of each company's GHG emissions from Scope 3 is relatively large, there tends to be a high percentage of companies whose disclosure of GHG reduction targets covers only up to Scope 1+2. This is why, as seen in financials, sectors with a markedly high percentage of GHG emissions from Scope 3 have considerably low emissions coverage rates.

The MSCI Target Score Card reveals that the GHG emissions coverage rate of companies' GHG reduction targets depends greatly on the status of their Scope 3 target disclosures. For this reason, as more progress is made in Scope 3 target disclosures, it is expected that targets will become more aligned with the actual state of GHG emissions.

Figure 2-17 GHG Emissions and Reduction Targets by Japanese Companies



(Source) Reproduced by permission of MSCI ESG Research LLC©2022

Figure 2-18 GHG Emissions and Reduction Target by Developed-market Companies

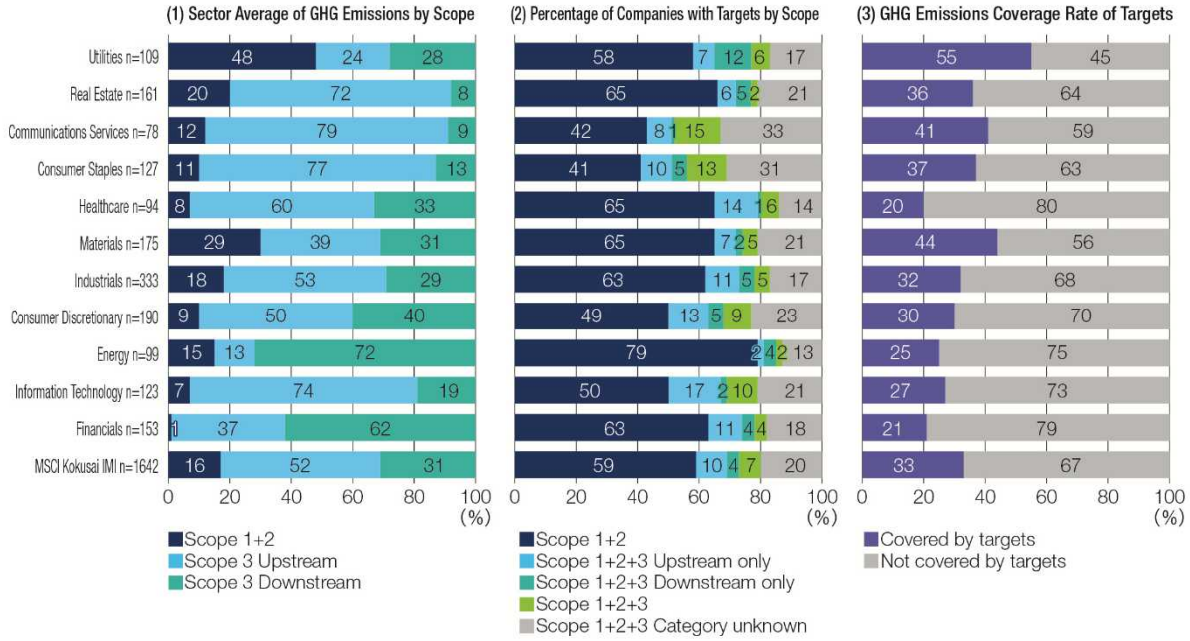


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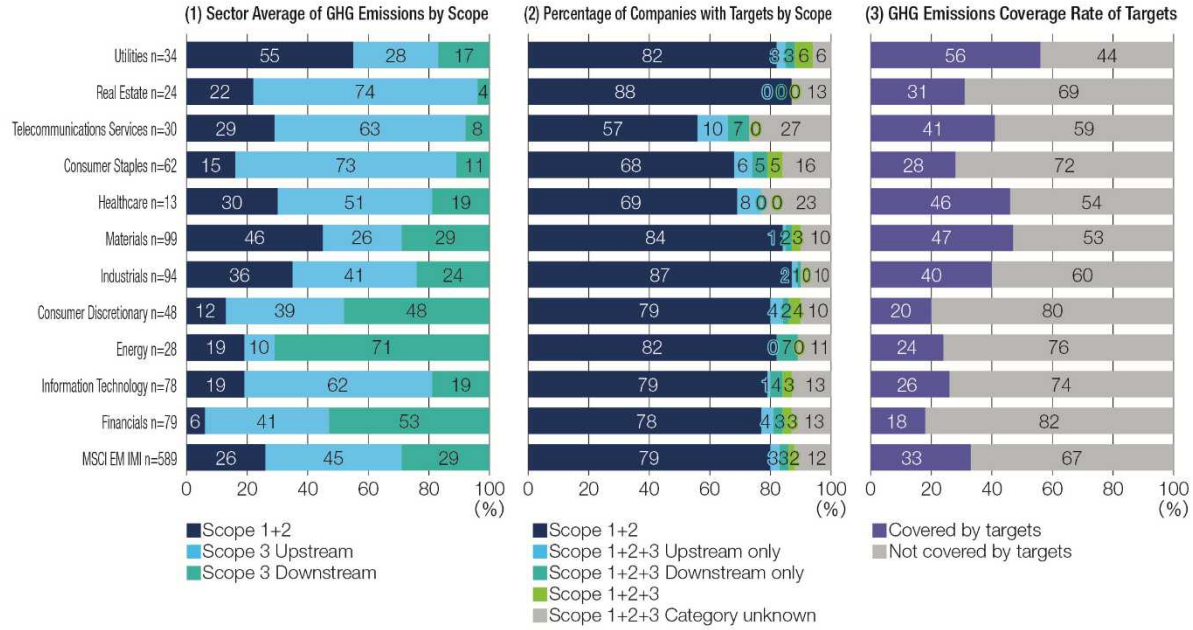
Figure 2-19 GHG Emissions and Reduction Target by Emerging-market Companies



(Note) In all three figures, the categories in the middle graph are defined as companies that have set targets to the following extents.
- Scope 1+2: Scopes 1 & 2. Also includes companies with targets in Scope 1 or Scope 2 only.
- Scope 1+2+3 Upstream only: In addition to Scope 1+2, also has targets in all or some of the 8 upstream categories of Scope 3. Also includes companies with targets in Scope 3 Upstream only.
- Scope 1+2+3 Downstream only: In addition to Scope 1+2, also has targets in all or some of the 7 downstream categories of Scope 3. Also includes companies with targets in Scope 3 Downstream only.
- Scope 1+2+3: In addition to Scope 1+2, also has targets in all or some of the upstream and downstream categories of Scope 3. Also includes companies with targets in Scope 3 Upstream and Downstream only.
- Scope 1+2+3 Category unknown: Targets are set for Scope 1+2+3, but the extent is not clearly stated. Also includes companies with targets in Scope 3 only but the extent is not clearly stated.
(Source) Reproduced by permission of MSCI ESG Research LLC ©2022

Analysis of Portfolio's Implied Temperature Rise

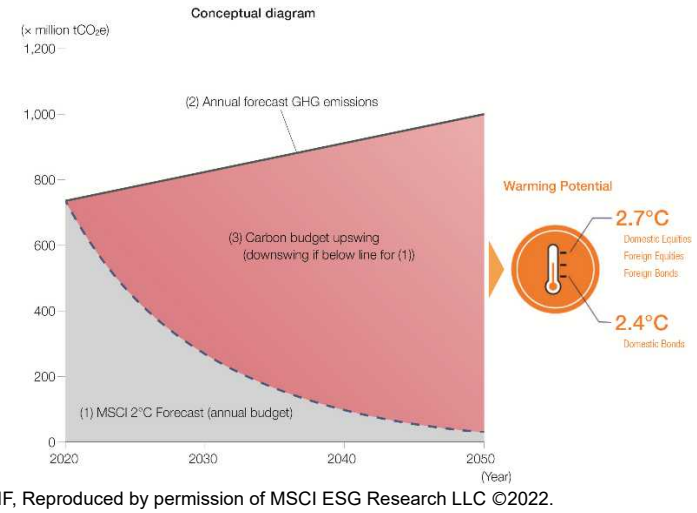
Analysis of Implied Temperature Rise

MSCI's Implied Temperature Rise (ITR) was used for this analysis. It evaluates the extent of potential to cause global warming from a target company's forecast greenhouse gas (GHG) emissions, shown as an increase in temperature.

In the calculation of temperature increase potential, (1) the carbon budget[1] available to limit temperature rise to 2°C announced by the Intergovernmental Panel on Climate Change (IPCC) is allocated in fair share based on factors such as the company's current revenue and carbon intensity levels. (2) The company's forecast future GHG emissions are calculated from its current GHG emissions and declared GHG emissions reduction targets, and the difference from (1) is calculated on an emissions basis. After dividing that difference by the allocated carbon budget to determine (3) to what extent emissions exceed or are below budget, (3) is multiplied by (1) and then, by multiplying the Transient Climate Response to Cumulative Emissions (TCRE) factor[2] based on scientific findings, the estimated GHG emissions are converted into a measurement of temperature increase (Figure 2-20).

The results of the analysis showed that the temperature rise potential across GPIF's portfolio was 2.7 °C for domestic equities, 2.4°C for domestic bonds, 2.7°C for foreign equities, and 2.7°C for foreign bonds. In all asset classes, forecast temperature rise exceeds 2°C. Looking at trends by asset class, temperature rise potential is relatively low for domestic bonds, while potential in all three other asset classes is at around the same level.

Figure 2-20 Temperature Rise Potential in GPIF Portfolio



(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC ©2022.

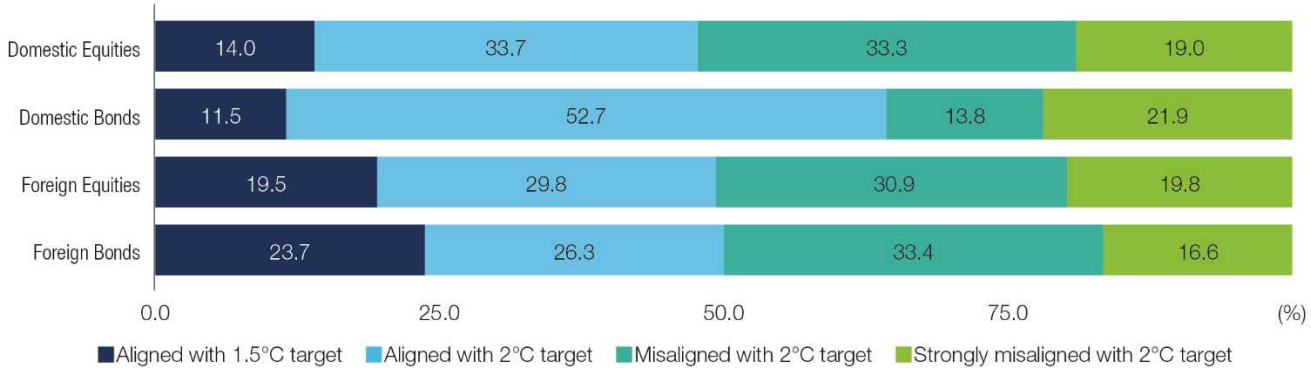
[1] Carbon budget is the upper limit of how much GHG emissions would be allowed until the temperature increase reaches a certain value due to global warming.
[2] This factor indicates the contribution to temperature rise of the release of 1Gt of GHG emissions.

Temperature Rise Potential in GPIF Portfolio by Category

This analysis classifies each company into four categories according to its temperature rise potential: "aligned with 1.5°C target," "aligned with 2°C target," "misaligned with 2°C target," and "strongly misaligned with 2°C target," and shows the percentage of companies in each category. The results of the analysis showed that the ratio of companies with a temperature rise potential of 2°C or below, namely, companies classified as "aligned with 1.5°C target" or "aligned with 2°C target," was 47.7% for domestic equities, 64.2% for domestic bonds, 49.3% for foreign equities, and 50.0% for foreign bonds. The ratio for domestic equities was slightly higher than those for the other three asset classes, which were all around 50%[3]. However, because each asset class had a smattering of companies classified as "strongly misaligned with 2°C target," with their potential rises spread widely from over 3.2°C to 10°C, the overall result is higher than 2°C (Figure 2-21 to Figure 2-25 show distribution of each asset).

Also, the rate of "aligned with 1.5°C target" of foreign equities and bonds is larger than that of domestic equities. In Target Score Card Analysis in previous chapter, GHG Emissions Coverage Rate of Targets of developed companies shows larger than that of domestic companies overall. The result aligns the result of Temperature Rise Potential because many foreign equities and bonds are developed companies.

Figure 2-21 Temperature Rise Potential in GPIF Portfolio by Category



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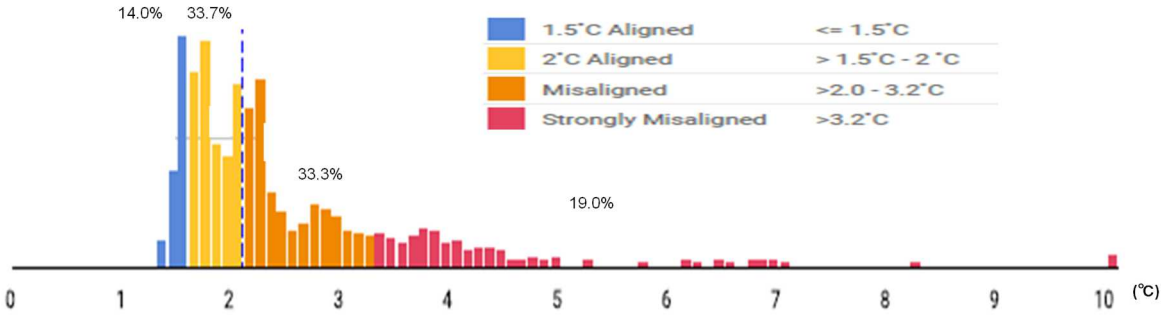
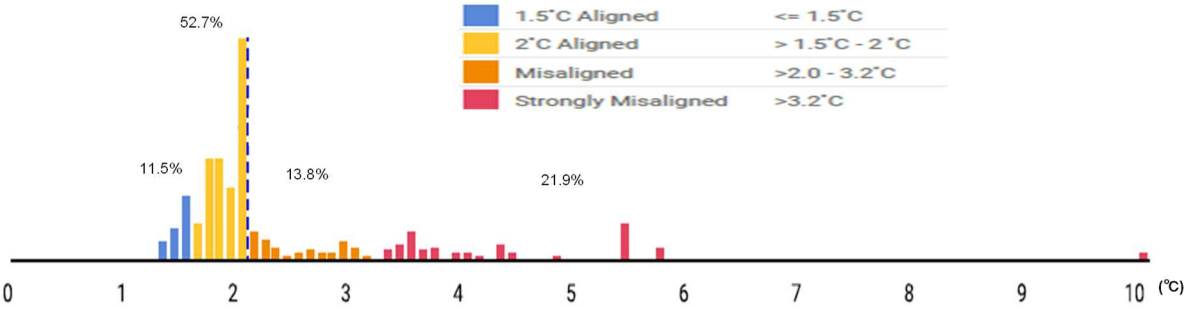
[3] These percentages do not include companies that are not included in evaluations and whose temperature rise potential has not been evaluated. Figure 2-21 to figure 2-25 are also the same.

Figure 2-22 Company Distribution of Global Warming Potential of Domestic Equity Portfolio



(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC ©2022.

Figure 2-23 Company Distribution of Global Warming Potential of Domestic Corporate Bonds Portfolio



(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC ©2022.

Figure 2-24 Company Distribution of Global Warming Potential of Foreign Equity Portfolio

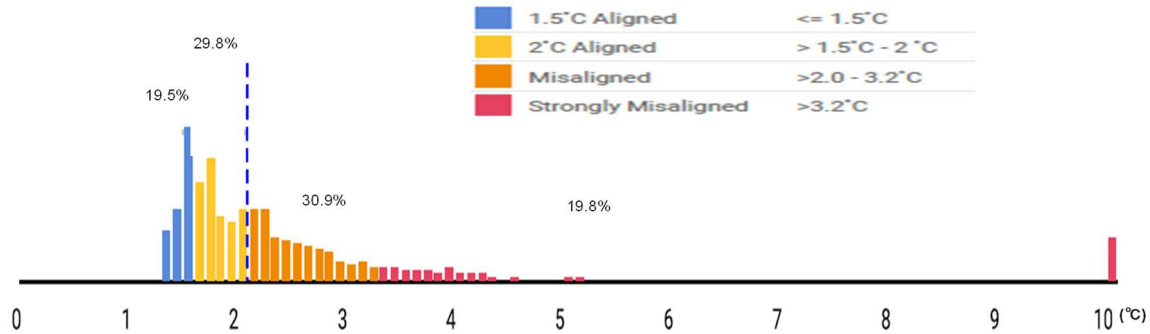


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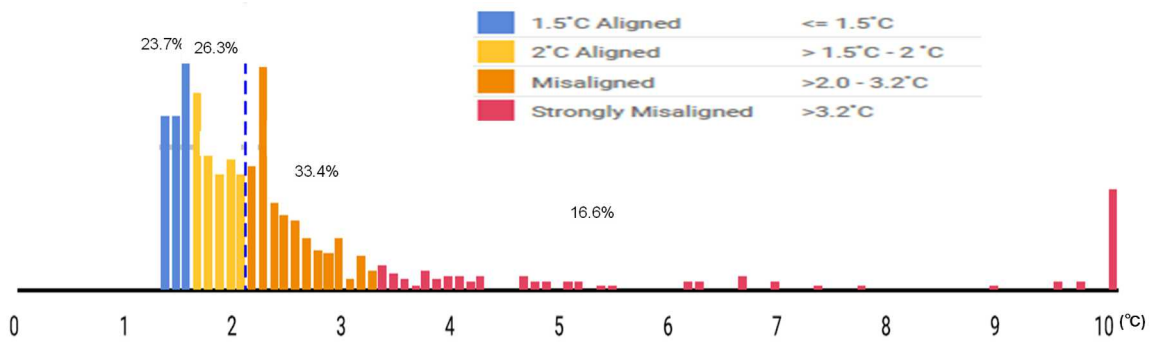
Figure 2-25 Company Distribution of Global Warming Potential of Foreign Corporate Bonds Portfolio



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TPI Management Quality Score Analysis

What is the Transition Pathway Initiative (TPI)?

Here, we look into the status of companies' management to a low carbon economy with the TPI Management Quality score (MQ score) with a bottom-up approach at the individual company level.

The TPI was established in 2017 by the Church of England's Church Asset Management Organization and the UK Environmental Protection Agency Pension Fund to assess companies' efforts in addressing climate change and transitioning to a low-carbon economy. FTSE Russell is a data partner of TPI and the Grantham Institute for Climate Change and Environment at the London School of Economics (LSE) as an academic partner. As of July 2022, about 130 institutional investors around the world with assets under management of over USD 50 trillion support the TPI. The TPI is operated by a TPI steering group consisting of representatives of asset owners, and TPI analysis results are published online by the Grantham Institute.

TPI MQ Score Methodology

The TPI MQ scores were developed by TPI to assess the quality of companies' management of their GHG emissions and of risks and opportunities related to transition to the low-carbon economy. The TPI MQ score assesses corporate climate change initiatives at six levels: "0: Unaware of (or not acknowledging) Climate Change as a Business Issue ", "1: Acknowledging Climate Change as a Business Issue ", "2: Building capacity", "3: Integrating Intro Operational Decision-Making", "4: Strategic assessment", and "5: Satisfies all indicators"（Figure2-26）. Companies must meet specific indicators to reach each score level, and achieving higher scores requires more sophisticated initiatives. The disclosure themes recommended by the TCFD are reflected in the evaluation of MQ Scores. Companies must disclose their GHG emissions and reduction targets to obtain a score of 3 or above. For this reason, companies working on TCFD responses tend to have higher MQ scores.

All indicators used for TPI MQ scores are included in the climate change theme of the FTSE Russell ESG ratings model and MQ Score was used as an evaluation criterion in the selection of the constituent stocks for the FTSE Blossom Japan Sector Relative Index, which GPIF has newly selected as an ESG index in FY2021, as a way of determining whether stocks with high carbon intensity are preparing for transition to decarbonization.

Figure 2-26 Evaluation Indicators Used in Measurement of MQ Score

Score 0 Unaware of (or not acknowledging) Climate Change as a Business Issue	Q1: Does the company acknowledge climate change as a significant issue for the business?
Score 1 Acknowledging Climate Chage as a Business Issue	Q2: Does the company recognise climate change as a relevant risk and/or opportunity for the business? Q3: Does the company have a policy (or equivalent) commitment to action on climate change?
Score 2 Building Capacity	Q4: Has the company set greenhouse gas emission reduction targets? Q5: Has the company published information on its operational (Scope 1 and 2) greenhouse gas emissions?
Score 3 Integrating Intro Operational Decision-Making	Q6: Has the company nominated a board member or board committee with explicit responsibility for oversight of the climate change policy? Q7: Has the company set quantitative targets for reducing its greenhouse gas emissions? Q8: Does the company report on Scope 3 emissions? Q9: Has the company had its operational (Scope 1 and/or 2) greenhouse gas emissions data verified? Q10: Does the company support domestic and international efforts to mitigate climate change? Q11: Does the company have a process to manage climate-related risks? Q12: (Applicable to some sectors only) Does the company disclose materially important Scope 3 emissions?
Score 4 Strategic Assessment	Q13: Does the company disclose its membership and involvement in organisations or coalitions dedicated specifically to climate issues? Q14: Has the company set long-term quantitative targets for reducing its greenhouse gas emissions? Q15: Does the company's remuneration for senior executives incorporate climate change performance? Q16: Does the company incorporate climate change risks and opportunities in their strategy? Q17: Does the company undertake climate scenario planning? Q18: Does the company disclose an internal price of carbon? Q19: Does the company ensure consistency between its climate change policy and the positions taken by trade associations of which it is a member?
Score 5 Satisfies all indicators	Satisfies all indicators

(Source) Prepared by GPIF based on *The Transition Pathway Initiative*, FTSE Russell

Features of the TPI MQ Scores

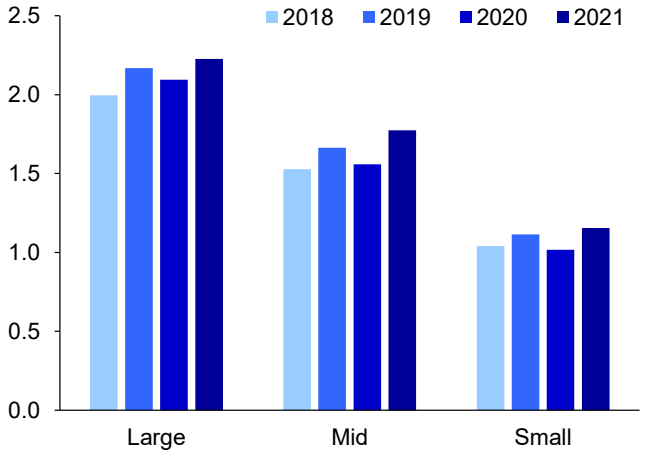
To confirm the status of companies' efforts in addressing climate change, we analyzed the MQ score distribution among the universe of all assessed companies for each period by company size, industry, and region.

First, when comparing MQ scores by company size (large, medium and small capitalizations), large cap companies tend to have high MQ scores on average while small cap companies tend to have low scores (Figure 2-27). In addition, looking at the breakdown of MQ scores 0 to 5 by company size, nearly half of the large cap companies in 2021 were assessed as "Integrating into Operational Decision-Making" (score 3) where GHG emissions and their reduction targets must be disclosed or higher. Some companies were assessed as " Strategic Assessment" (score 4, Figure 2-28). On the other hand, for small cap companies, the percentage of companies with a score 3 was about 10%, and only a few companies were assessed as " Strategic Assessment" (score 4). Although many small cap companies have started to manage climate change, it can be considered that they are still in the early stages, such as " Acknowledging Climate Change as a Business Issue" (score 1) and "Building Capacity" (score 2). These results are thought to be largely attributable to the difference in management resources between large and small cap companies.

Next, when comparing the average TPI MQ scores by industry, there was a large difference in the scores depending on the industry type (Figure 2-29). There is a clear difference in scores by industry, with the average MQ score for Utilities being about 2.1 while the average MQ score for Healthcare being about 1.2. The three industries with a large carbon footprint which are Utilities, Energy, and Materials, have relatively high average MQ scores. This means that the industries with higher GHG emissions appear to be making efforts to integrate climate change and are being positively evaluated for it by the TPI MQ assessment. Looking at the breakdown of MQ scores by industry, the percentage of companies with a score 3 or higher in Utilities is higher than in other industries (Figure 2-30).

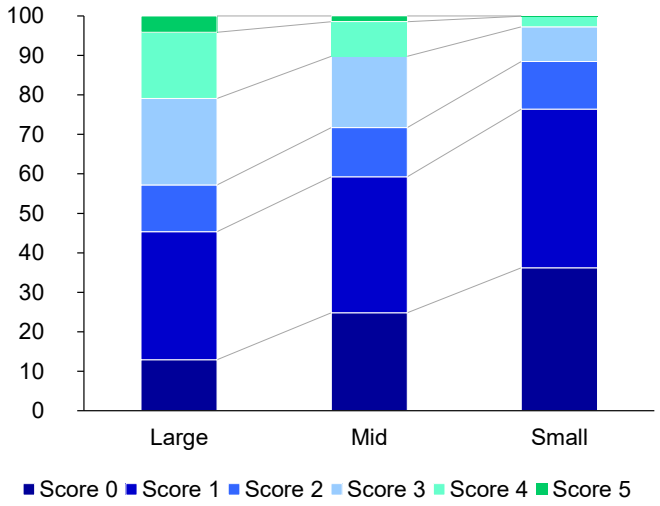
Next, we analyzed the distribution of TPI MQ scores by region (Figure 2-31). Europe (developed countries) has the highest while Asia Pacific has the lowest average MQ scores among all regions. The MQ score of Japan is also relatively low. Looking at the breakdown of the MQ scores of Japanese companies, while a certain percentage of companies scores 3, the percentage of companies with scores 0 and 1 is higher than in Europe (developed countries) and North America, indicating a difference in companies' climate change management efforts (Figure 2-32). The number of assessed companies in the MQ score universe has increased from 4,983 in 2018 to 6,198 in 2021 (Figure 2-33). Among them, the number of Japanese companies has increased significantly from 759 companies in 2018 to 1,348 companies in 2021, compared to other regions. The number of assessed companies in Japan is increasing mainly due to the addition of small cap companies, which partly explains the low average MQ score of Japan. In addition, as shown in Figure 2-32, the percentage of MQ scores 4 and 5 of Japanese companies is lower than that of European (developed companies). Further efforts are expected by Japanese companies to improve their climate change management efforts.

Figure 2-27 TPI MQ Score Comparison by Company Size (Overview)



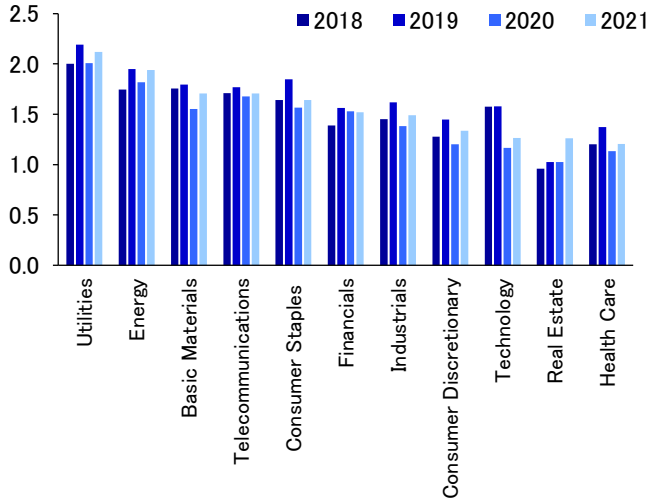
(Note) Not all companies are included in 2021 due to some companies that have not completed the assessment of the fact that the TPI assessment for 2021 was still underway as of at July 2022. Not included companies that are not classified as large, mid, or small caps such as micro cap.
(Source) FTSE Russell

Figure 2-28 TPI MQ Score Comparison by Company Size (Breakdown) (%)



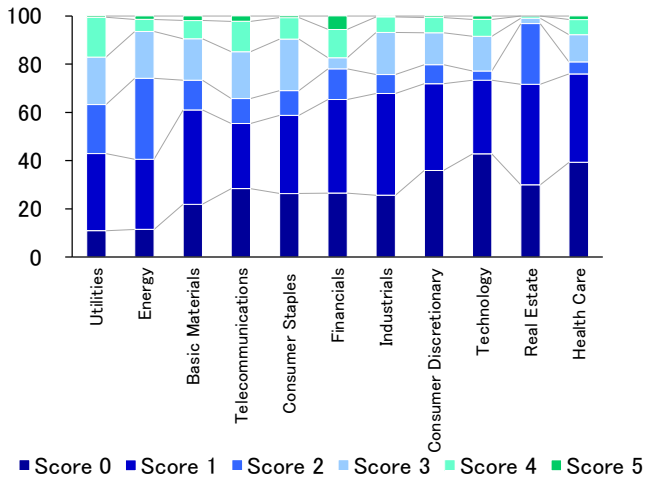
(Note) As of 2020. (Not all companies are included in 2021 due to some companies that have not completed the assessment of the fact that the TPI assessment for 2021 was still underway as of at July 2022). Not included companies that are not classified as large, mid, or small caps such as micro cap. The percentage calculated with the number of companies.
(Source) FTSE Russell

Figure 2-29 MQ Score Comparison of Industry Average (Overview)



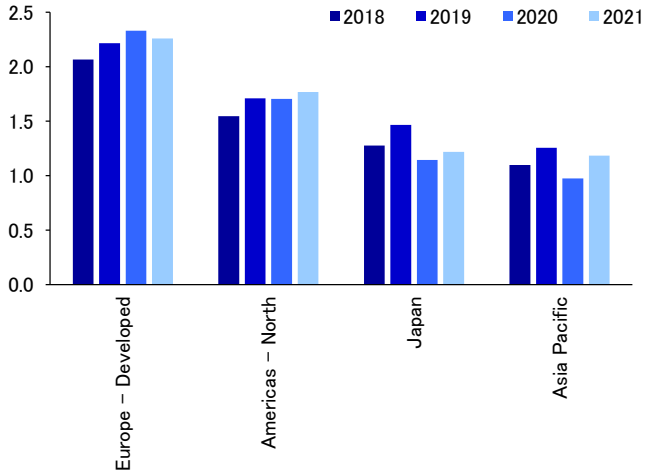
(Note) Not all companies are included in 2021 due to some companies that have not completed the assessment of the fact that the TPI assessment for 2021 was still underway as of at July 2022.
(Source) FTSE Russell

Figure 2-30 MQ Score Comparison by Industry Average (Breakdown) (%)



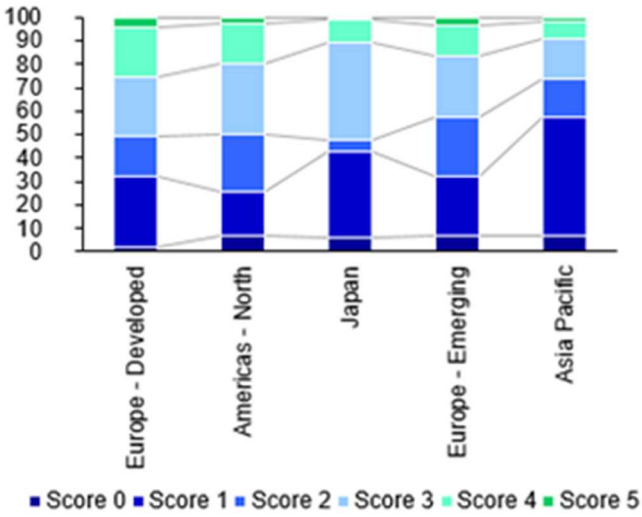
(Note) As of 2020. (Not all companies are included in 2021 due to some companies that have not completed the assessment of the fact that the TPI assessment for 2021 was still underway as of at July 2022).
(Source) FTSE Russell

Figure 2-31 TPI MQ Score Comparison by Region (Overview)



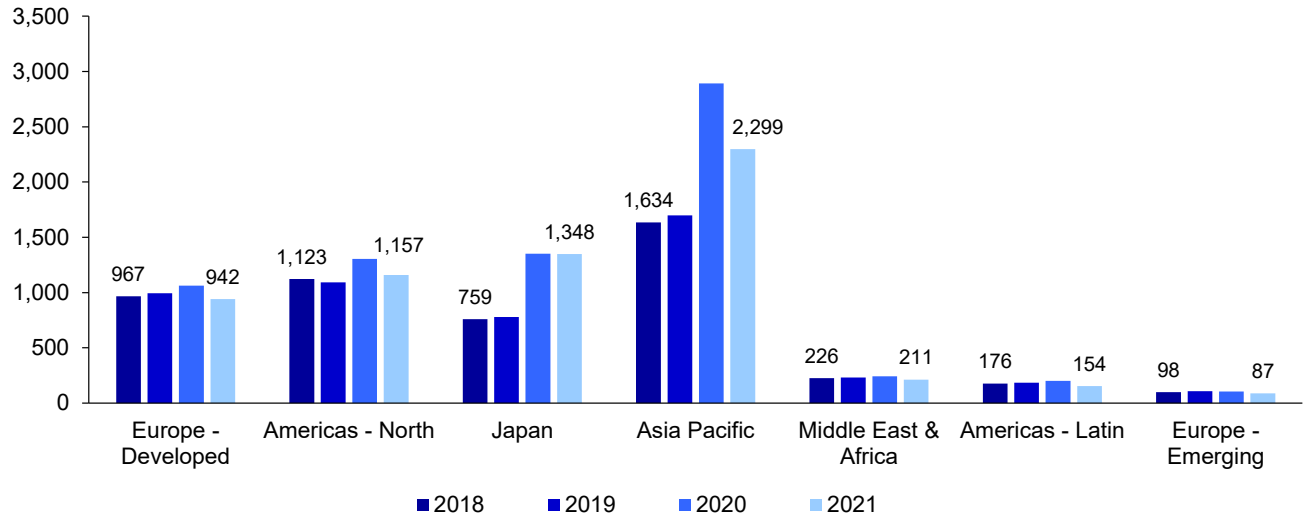
(Note) Not all companies are included in 2021 due to some companies that have not completed the assessment of the fact that the TPI assessment for 2021 was still underway as of at July 2022. Asia Pacific excludes Japan.
(Source) FTSE Russell

Figure 2-32 TPI MQ Score Comparison by Region (Breakdown) (%)



(Note) As of 2020. (Not all companies are included in 2021 due to some companies that have not completed the assessment of the fact that the TPI assessment for 2021 was still underway as of at July 2022). Only Europe (developed countries), North America, Japan, Europe (Emerging countries),and Asia Pacific (ex Japan) in the chart. The percentage calculated with the number of companies.
(Source) FTSE Russell

Figure 2-33 Number of Companies in Universe (Number of Assessed Companies)



(Note) Not all companies are included in 2021 due to of the fact that the TPI assessment for 2021 was still underway as of July 2022.
（Source） FTSE Russell

Analysis of Relationship between MQ Score and Carbon Intensity

If MQ score accurately rates the quality of a company's action toward transition to a carbon-free society, it is expected that the rank of its MQ score will affect its carbon intensity.

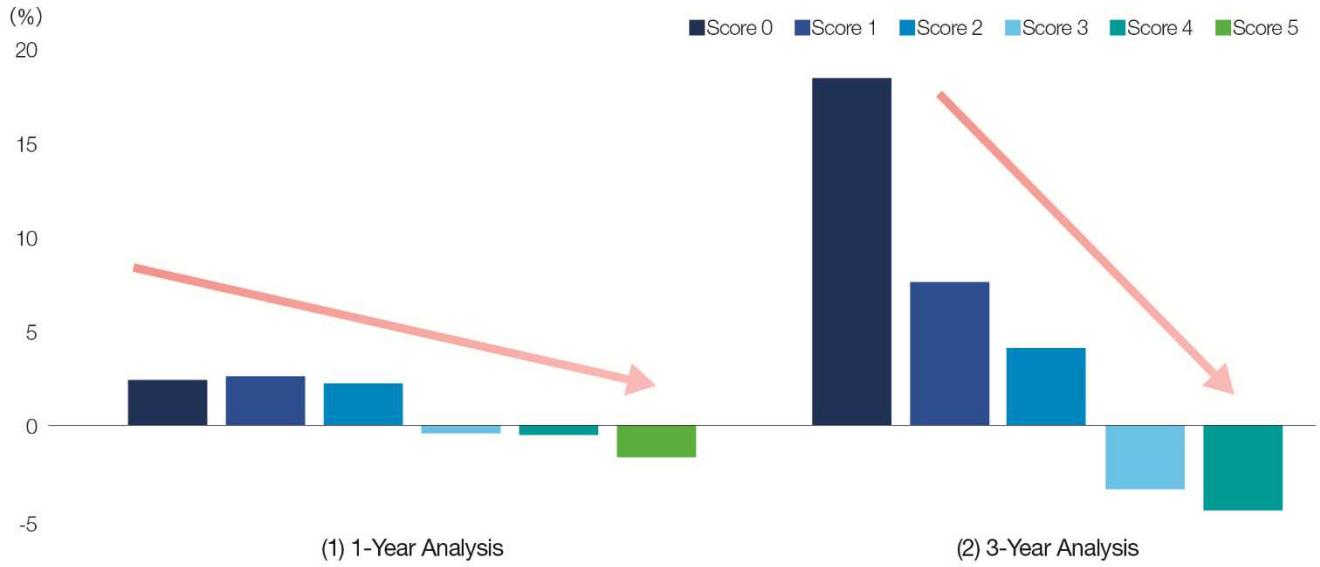
First, based on the annual MQ Scores for 2018, 2019, and 2020, we observed single year changes in carbon intensity by calculating the average rate of change in carbon intensity for each score one year later for each year (Figure 2-34 (1)). For example, this classifies the companies for each 2018 MQ Score and examines how carbon intensity has changed on average one year later for each group of companies. Here, the analysis was performed for the three periods of 2018, 2019, and 2020, and the average of the three results is shown on the graphs below. As a result, the groups of companies with low MQ Scores of 0, 1 and 2 showed increases in average carbon intensity, whereas it decreased in the groups of companies with high MQ Scores of 3, 4 and 5. The difference in results between the group of Score 2 companies, evaluated as "Building Capacity," and the group of Score 3 companies, evaluated as "Integrating Intro Operational Decision-Making" is particularly distinctive.

By rights, rather than believing that improving the quality of response to the risks and opportunities of transition to a low-carbon economy would bring an improvement in carbon intensity after one year, it would be more natural to consider that such effect would manifest over several years.

Therefore, to ascertain the change over a slightly longer period, based on the 2018 MQ Scores, we examined the average rate of change in carbon intensity of the groups of companies at each Score level after three years, until 2021 (Figure 2-34 (2)). The groups of companies with higher MQ scores in 2018 showed a tendency for carbon intensity to decline on average after three years. Further, that tendency was more conspicuous in the results in (2) for the longer period than for the single-year results in (1).

As shown above, although it should be noted that this analysis is for an extremely limited period, in that period, the carbon intensity of companies with high MQ Scores tended to fall, and these results confirm that such a tendency becomes more evident when viewed over longer periods.

Figure 2-34 Average Rate of Change in Carbon Intensity for Each MQ Score



(Note) (1) 1-Year Analysis in the graph shows the average of the three single-year analyses of changes in companies' carbon intensity after one year, from the MQ Scores for each of 2018, 2019, and 2020. (2) 3-Year Analysis shows the change in companies' carbon intensity after three years until 2021 based on the 2018 MQ Scores.
(Note) Score 5 was used only in analysis from 2020 onward, when it became available.
(Source) FTSE Russell

Chapter 3: Analysis of Climate Value-at-Risks

Analysis of Risk and Opportunity by Climate Value-at-Risk

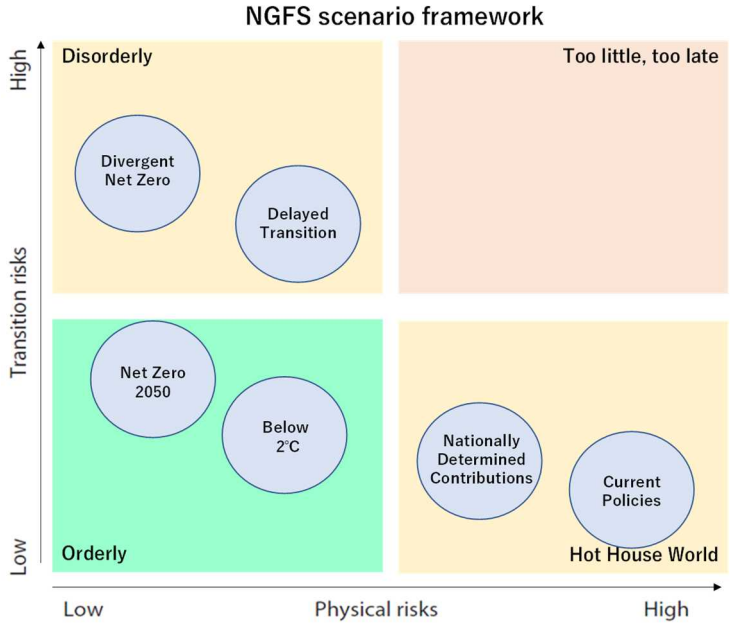
NGFS Climate Scenarios

MSCI's Climate Value-at-Risk (CVaR) measures the impact of climate change-related policy changes and hazards on corporate value. CVaR allows for an integrated analysis of not only the "risks" to corporate value from climate change, but also the "opportunities".

GPIF uses CVaR to analyze the climate change risk of its portfolio in line with the TCFD's recommendations. CVaR is composed of "transition risks" and "physical risks". "Transition risks" is a combination of "technology opportunities" that represent profit-earning opportunities of technologies that can gain an advantage as regulations are tightened, and "policy risks" which represent the impact of regulations related to greenhouse gas emissions. "Physical risks" that combine risks and opportunities from the effects of changes in the natural environment and hazards associated with climate change.

This year, we continued to update our CVaR analysis model following the "ESG Report 2020". The most significant update was to reflect the climate scenarios released in June 2021 by the Network of Central Banks and Supervisors for Greening the Financial System (NGFS). The NGFS is an international network of central banks and financial supervisors to examine financial supervisory responses to climate change risks. The six scenarios are aligned with the NGFS scenario framework and are located in one of four categories according to the level of transition risks and physical risks (Figure 3-1 and 3-2).

Figure 3-1 NGFS Scenario Framework



(Source) Reproduced by GPIF based on NGFS "NGFS Climate Scenarios for central banks and supervisors".

The category of "Orderly" is a scenario in which emission reduction policies are introduced early and then become progressively more stringent, with both physical and transition risks remaining within a relatively small range; there are two scenarios in the "Orderly" category. In the "Net Zero 2050" scenario, strict climate policies, technological innovation, and other measures aim to achieve zero global carbon dioxide emissions net of sinks and removals (hereafter "net zero") by around 2050, and all GHG emissions in Japan, the United States, and the EU region achieve net zero. The other is the "Below 2°C Transition" scenario, in which climate policies are gradually tightened and a 67% chance of deterring a temperature increase below 2°C is assumed.

The "Disorderly" category is characterized by delayed implementation of emission reduction policies or lack of alignment of policies and measures across countries/regions and sectors, resulting in high transition risk, but low physical risk as emission reduction policies are assumed to be eventually implemented. The "Disorderly" category also includes two scenarios: "Divergent Net Zero," in which net zero is achieved around 2050, but the severity of climate policies introduced varies across sectors, and the early phase-out of oil use is more costly. The "Delayed Transition" scenario is a scenario in which net zero is achieved around 2050, but costs are higher due to earlier elimination of oil use because of the different stringencies of climate policies introduced across sectors. Delayed Transition is a scenario in which annual emissions do not decline until 2030 and strong climate policies are needed to achieve below 2°C, but GHG reductions are limited.

Finally, there are two scenarios in the "Hot House World" category: "Nationally Determined Contributions" assumes that all climate policies to which countries have committed will be implemented (including those not yet implemented), and "Current Policies" assumes that only those climate policies that have been implemented will remain in place and that the physical risks are high. The "Hot House World" category assumes that climate change mitigation efforts are globally inadequate and physical risks are high, while emission reduction policies are implemented only in a limited number of regions, resulting in a low transition risk.

Figure 3-2 Six NGFS Scenarios

Category	Scenario	Physical Risks		Temperature Rise				
			Transition Risks		Policy Reaction	Technology Change	CO_2 Removal (CDR)	Regional Policy Variation
Orderly	(1) Net Zero 2050	Low	1.5°C	Medium	Immediate, smooth	Fast change	Medium use	Medium variation
	(2) Below 2°C	Medium	1.7°C	Medium	Immediate, smooth	Moderate change	Medium use	Low variation
Disorderly	(3) Divergent Net Zero	Low	1.5°C	High	Immediate but divergent	Fast change	Low use	Medium variation
	(4) Delayed Transition	Medium	1.8°C	High	Delayed	Slow/ Fast change	Low use	High variation
Hot House World	(5) Nationally Determined Contributions: NDCs	High	Up to 2.5°C	Low	NDCs	Slow change	Low use	Low variation
	(6) Current Policies	High	3°C+	Low	None/Current Policies	Slow change	Low use	Low variation

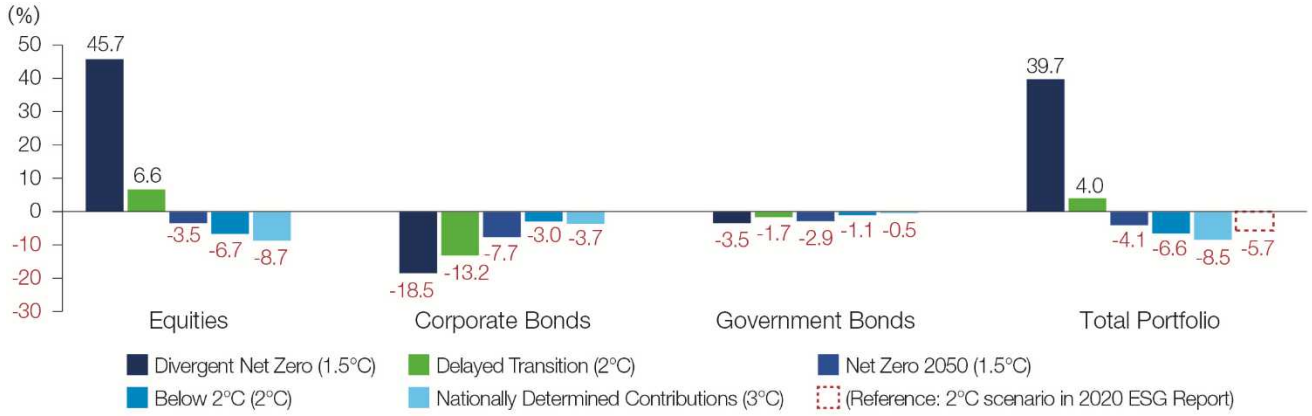
(Note) “Temperature rise” refers to the rise in temperature from pre-industrial levels to the end of the 21st century. Red cells indicate a high level of risk, while blue cells indicate a low level of risk.
(Source) Prepared by GPIF based on NGFS Climate Scenarios for Central Banks and Supervisors (June 2021), etc.

CVaR Analysis by NGFS Climate Scenario

In this section, to identify the overall trends of each scenario, we calculated Aggregated CVaR, combining the technology opportunities, policy risks, and physical risks, based on portfolio data as of March 31, 2022 by using NGFS scenario. After dividing this into the four categories of “equities,” “corporate bonds,” “government bonds,” and “total portfolio,” we compared the analysis results of five climate scenarios, namely “Net Zero 2050,” “Divergent Net Zero,” “Below 2°C,” “Delayed Transition,” and “Nationally Determined Contributions (NDCs)” (Figure 3-3). To assist with understanding the characteristics of the scenarios, the temperature increase range defined by MSCI is provided next to the name of each scenario. For example, the Net Zero 2050 scenario shows that the scenario is consistent with the 1.5°C pathway. In this chapter, excluding analysis which any scenarios and temperature targets was written clearly, all analysis used “Net Zero 2050” scenario.

Divergent Net Zero and Delayed Transition, which are classified as disorderly scenarios, are seen as having a large positive impact in the equities category and a large negative impact in the corporate bonds category, with the overall net impact on the portfolio being positive. Comparing the other three scenarios, similarly to the previous fiscal year's model, in the corporate bonds category, the risks of temperature rise-curbing scenarios are great, while on the other hand, in the equities and total portfolio categories, the greater the curbing of temperature rise in the scenario, the smaller the risks became. This fiscal year, we conducted CVaR analysis on government bonds for the first time. The characteristics in this category were generally similar to those of the corporate bonds. For the total portfolio, there was no major difference between this fiscal year's Below 2°C scenario (-6.6%) and the data calculated for the 2°C scenario in the FY2020 ESG Report (AIM/CGE)[1] (-5.7%).

Figure 3-3 Comparison of Aggregated CVaR by Portfolio



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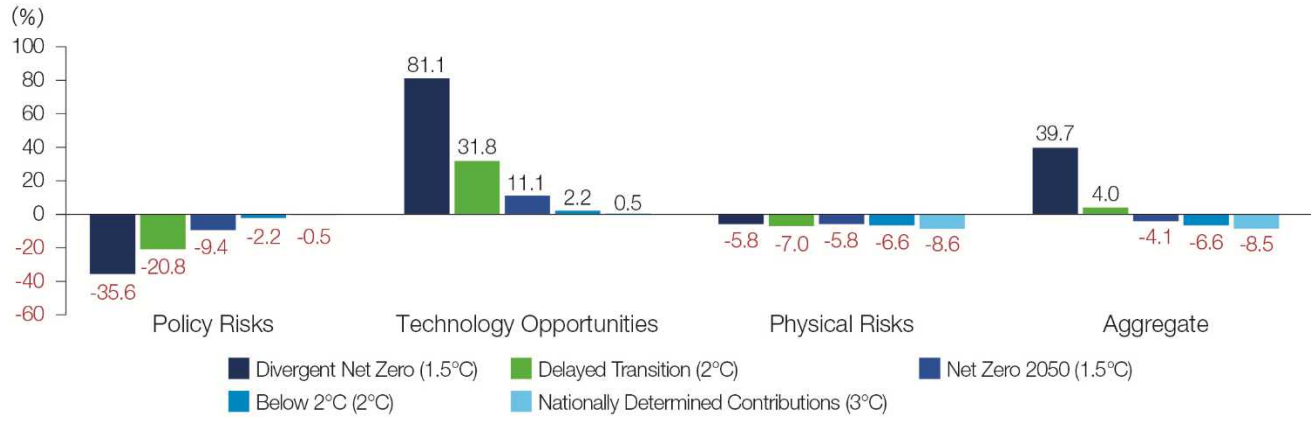
Analysis of Aggregated CVaR by Scenario and Category

Next, we categorized the aggregate CVaR for the total portfolio from the previous section into the three individual CVaR, namely policy risks, technology opportunities, and physical risks, and conducted a comparative analysis for each climate scenario (Figure 3-4). In Divergent Net Zero and Delayed Transition, which are classified as disorderly scenarios, policy risks presented large risks, and technology opportunities showed a major positive impact, the result of which was a net positive "aggregate" impact. Comparing the other three scenarios, Net Zero 2050, Below 2°C, and NDCs, we found that, the scenarios with the largest curbing of temperature rise had larger policy risks. On the other hand, technology opportunities were found to have a larger positive impact the greater the curb on temperature rise in the scenario. These results are likely due mainly to the fact that the Net Zero 2050 scenario is one of curbing temperature rise through the implementation of stringent climate

[1] AIM-CGE (Asia-Pacific Integrated Model/Computable General Equilibrium Model) is a model developed by Japan's National Institute for Environmental Studies (NIES) and others.

policies and the achievement of technological innovations. Further, the scenarios with the greater curbing of temperature rise resulted in smaller physical risks, and, as a result, in the aggregate category, the scenarios with larger curbing of temperature rise generally involved smaller risks. Based on the results of these various analyses, it could be concluded that there is a high chance that initiatives to curb temperature rise will result in more technology opportunities and fewer physical risks, leading to a fall in aggregate risk for the total portfolio.

Figure 3-4 Comparison of CVaR by Scenario



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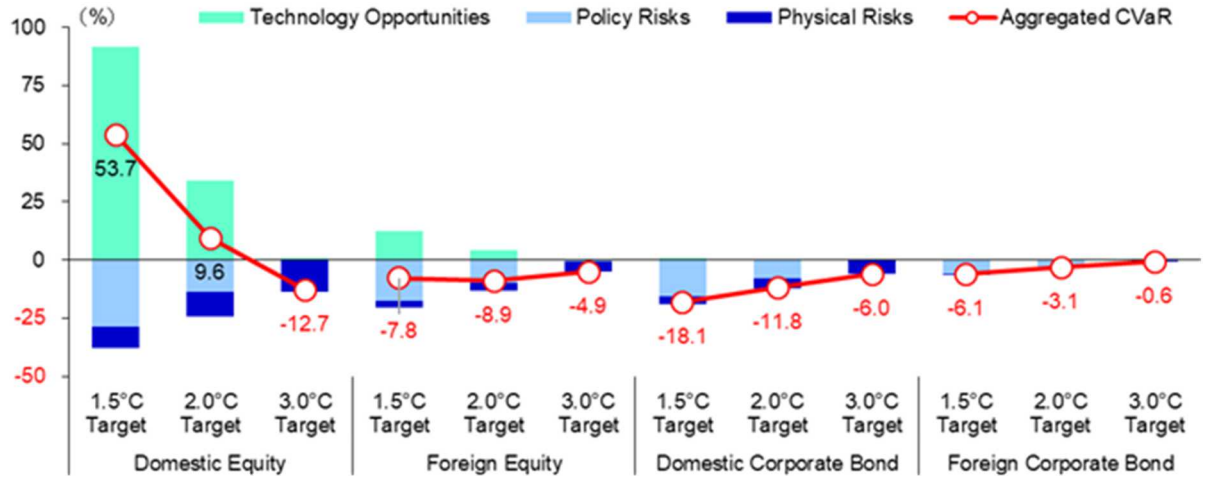
GPIF Portfolio CVaR Analysis by Temperature Target

In the four asset class categories of domestic equities, foreign equities, domestic corporate bonds, and foreign corporate bonds, we compared the following CVaR results, "Aggregated CVaR," "Technology Opportunities," "Policy Risks," and "Physical Risks" by the three temperature targets of "1.5°C target," "2°C target," and "3°C target" (Figure 3-5). Here, based on the aforementioned temperature rise range, we assume that the "1.5°C target" is a simple average of "Divergent Net Zero (1.5°C)" and "Net Zero 2050 (1.5°C)," the "2°C target" is a simple average of "Below 2°C (2°C)" and "Delayed Transition (2°C)," and the "3°C target" is "Nationally Determined Contributions (3°C) to align more closely with our last ESG Report.

Figure 3-5 GPIF Portfolio Climate Target - Summary Table



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(Reference) CVaR by Temperature Target - Detailed Comparison among Temperature Target Scenarios

The summary table, Figure 3-5, presented the simple average results for the same temperature target, however the pathways and the conditions are different for each of these scenarios. Therefore, as a reference, we have identified CVaR values based on the risk ranges of " Divergent Net Zero (1.5°C)" and " Net Zero 2050 (1.5°C)" for the "1.5°C target" and " Below 2°C (2°C)" and " Delayed Transition (2°C)" for the "2°C target". Please note that the "3°C target" represents only one scenario, " Nationally Determined Contributions (3°C)," and therefore only its risk is shown.

In the “Aggregated CVaR”, domestic equities showed less risks with more stringent temperature targets, and showed positive values on average for the "1.5°C target" and "2°C target" (Figure 3-6). For the other three assets, the risks generally increased with more stringent temperature targets, but the numerical difference between the targets was smaller than that for domestic equities.

In terms of "Policy Risks" the more stringent the temperature target, the greater the risk on average for all assets (Figure 3-7). The more stringent the temperature target, the greater the policy constraints, which in turn is expected to have a greater impact on corporate value.

In the "Technology Opportunities" category, domestic equities and foreign equities had, on average, more significant positive impacts with more stringent temperature targets (Figure 3-8). In particular, the value of "1.5°C target" in domestic equities was significantly larger. In addition, domestic corporate bonds and foreign corporate bonds showed limited impact for both targets. For corporate bonds, while the increase in earnings from "Technology Opportunities" positively contributes to bond prices through the reduction of default risk, the impact is limited because the bonds are never redeemed above par value. On the other hand, for equities, the positive effects of "Technology Opportunities" are substantial

due to the cumulative effect of very long-term cash flows. Therefore, we believe that a difference in trend exists between the two assets.

In terms of "Physical Risks," the more stringent the temperature target, the smaller the risk on average for all assets (Figure 3-9). This is consistent with the assumption that the higher the temperature rise, the greater the likelihood of various extreme hazards.

Through each analysis, it can be seen that the CVaR results for domestic equities can vary significantly in both positive and negative directions. In particular, the "1.5°C target" and the "2°C target" for domestic equities produced positive values in the "Aggregated CVaR" because the positive impact of "Technology Opportunities" outweighed the negative impact of "Policy Risks" and "Physical Risks. This suggests that more progress in efforts to mitigate rising temperatures in the future could increase the investment returns of domestic equities.

Figure 3-6 GPIF Portfolio Climate Target - Aggregated CVaR

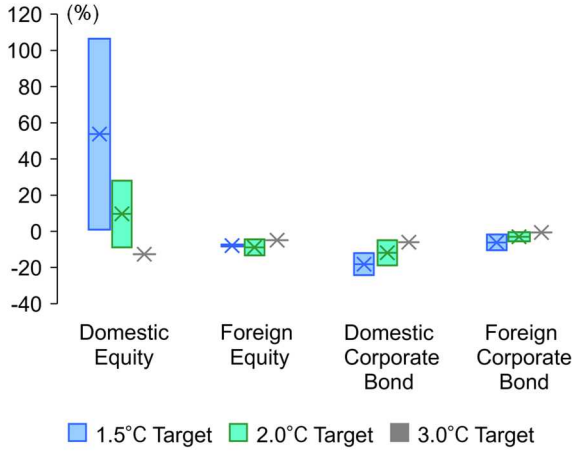

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Figure 3-7 GPIF Portfolio Climate Target - Policy Risks

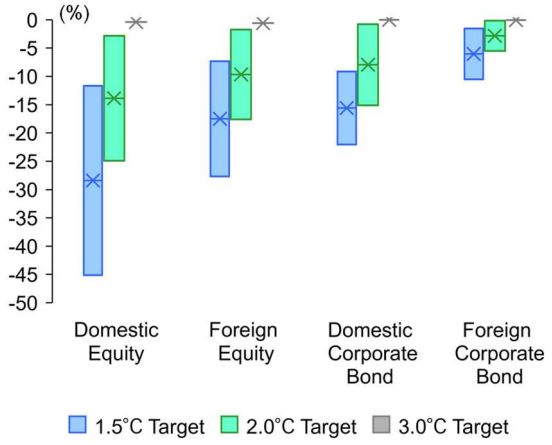

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Figure 3-8 GPIF Portfolio Climate Target - Technology Opportunities

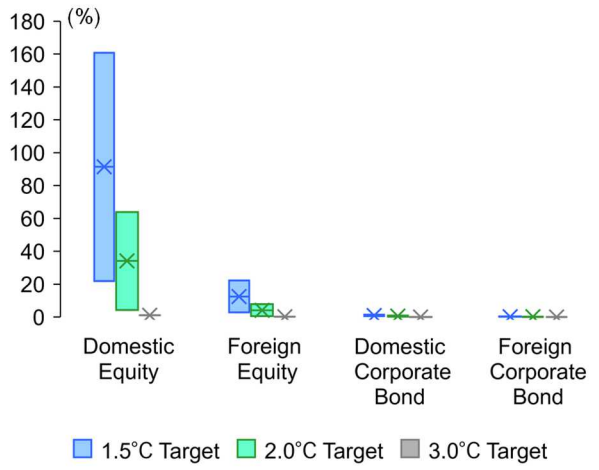

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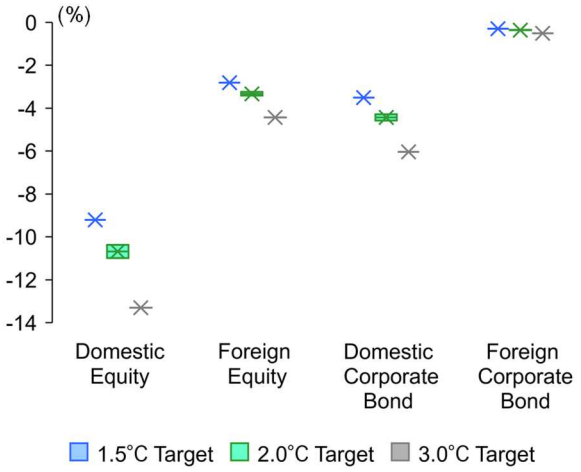
Figure 3-9 GPIF Portfolio Climate Target - Physical Risks



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Technology Opportunities

Technology Opportunities and Patent Score

Here, we investigate the patent scores used to calculate technology opportunities for companies included in GPIF's equity and corporate bond portfolios. While analysis results are affected by the amounts invested in individual companies, the portfolio at the time of this analysis is generally in line with the policy asset mix. As such, in terms of equities, the portfolios do not deviate significantly from policy benchmarks. The patent score calculation totals all low-carbon technology patents held by a given company and reflects any change in the number of such patents[1]. Compared with the previous year, despite there being no major change in the composition, patent scores have increased significantly in all asset classes. In particular, the patent score of the domestic equity portfolio increased substantially than the other asset classes, with domestic companies in the automotive and energy supply sectors scoring exceptionally high.

Looking at patent scores by sector, the consumer discretionary sector, which includes automotive manufacturers, scored markedly higher compared with other sectors in the domestic equity and domestic corporate bond portfolios. Within these sectors, "automobiles" had the highest patent scores, followed by "energy supply" (Figures 3-10 and 3-12). Meanwhile, in the case of foreign equities and foreign corporate bonds, the scores for industrials are the highest, with patents related to "planes" major contributions. In the information technology and industrials sectors, "information technology" scored highly, while "automobiles" scored highly in the consumer discretionary sector, similar to domestic equities and bonds. In GPIF's equity and corporate bond portfolio, weighted average score of domestic equities is much larger than that of foreign equities because the investment ratio of Japanese companies with high patent scores is larger compared to foreign companies with high level of patent scores (Figures 3-11 and 3-13).

[1] The evaluation of patent scores is based on "forward citations," which is the number of patents cited in other parties' patent applications, "backward citations," which is the number of other parties' patents cited when filing one's own patent application, "market coverage," or the total GDP of countries to which the patent application was filed, and the number of tagged CPC patent groups as "cooperative patent classification (CPC) coverage."

Figure 3-10 Technology Opportunities: Domestic Equity Portfolio

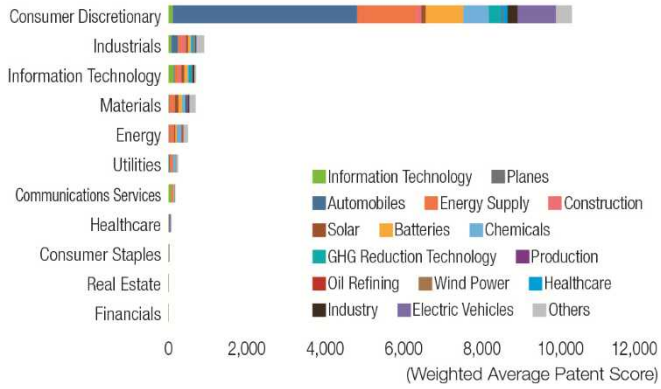

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Figure 3-11 Technology Opportunities: Foreign Equity Portfolio

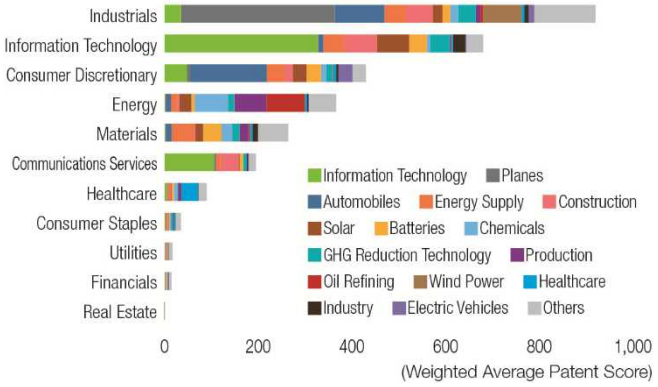

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Figure 3-12 Technology Opportunities: Domestic Corporate Bond Portfolio

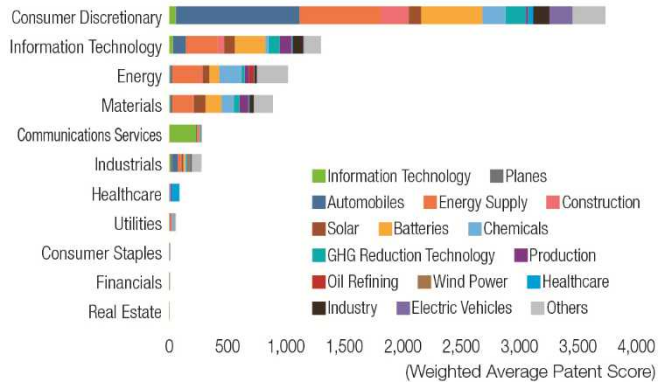

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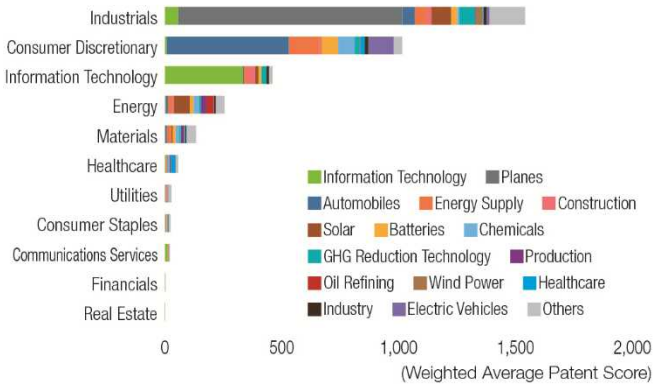
Figure 3-13 Technology Opportunities: Foreign Corporate Bond Portfolio



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Policy Risks

Policy Risks CVaR of Portfolio

For policy risks, which, along with technology opportunities, form part of transition risks, we conducted analysis based on the Net Zero 2050 scenario. Similar to the previous fiscal year, the analysis looked mainly at four asset classes in GPIF's portfolio: domestic corporate bonds, foreign corporate bonds, domestic equities, and foreign equities. The risks in Scopes 1 & 2, Scope 3, and total risks were analyzed for the major industry sectors in each asset class. Changes from the previous fiscal year were also analyzed (Figures 3-14 to 3-17).

For overall policy risk CVaR, including Scope 3, results for domestic equities showed that there were greater risks in the utilities sector (which includes electric power and other companies), the energy sector (which includes companies such as fossil fuel mining companies), and the materials sector, while risks in the healthcare, communications services, and financial sectors remain low. This followed a similar trend to the previous fiscal year. In terms of change from the previous fiscal year across all sectors, risks in the energy sector decreased by 4.2 percentage points. Stocks in the energy sector have relatively high policy risks, which means potential for the sector's risk to change significantly due to changes in individual stocks. These individual stock-related factors are likely to be behind this result. Meanwhile, Scope 3 risks tend to be smaller than those of Scopes 1 & 2 in all sectors[1]. This is due to the fact that, although absolute Scope 3 greenhouse gas emissions are generally large, this is not necessarily the case when companies' assumed burden rates are taken into account. By sector, risks in the utilities and energy sectors remained high, showing a similar trend to Scopes 1 & 2.

Foreign equities showed the same trend as the previous fiscal year, with risks in the utilities, energy, and materials sectors remaining high. In changes from the previous fiscal year, risks in the energy sector also decreased in a similar trend to domestic equities.

In the corporate bond analysis, similarly to equities, the three sectors with the highest risks remain the utilities, energy, and materials, both domestically and overseas. In changes from the previous fiscal year, there was a decrease in risks in the materials sector.

[1] The amount of burden on the company is determined by the "assumed burden rate" for each category. For details, see "(Appendix) CVaR: Explanation of Methodology" on page 69.

Figure 3-14 Policy Risk: Domestic Equity Portfolio (%)

Sector	Policy Risk CVaR	Scope 1+2	Scope 3	Change from previous fiscal year (percentage points)
Healthcare	-2.0	-1.1	-0.9	0.1
Communications Services	-2.5	-1.4	-1.0	-0.2
Financials	-2.6	-1.1	-1.6	0.1
Information Technology	-2.7	-1.6	-1.2	0.2
Real Estate	-5.2	-3.1	-2.2	0.4
Consumer Discretionary	-12.3	-2.7	-9.5	0.3
Consumer Staples	-12.5	-7.2	-5.3	0.1
Industrials	-13.2	-8.5	-4.7	-1.7
Materials	-38.8	-31.7	-7.1	0.8
Energy	-82.4	-40.9	-41.5	4.2
Utilities	-89.3	-58.2	-31.2	-2.5

(Note) Changes from the previous fiscal year are changes in CVaR for policy risks from the previous fiscal year calculated for the same model/scenario.
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Figure 3-15 Policy Risk: Foreign Equity Portfolio (%)

Sector	Policy Risk CVaR	Scope 1+2	Scope 3	Change from previous fiscal year (percentage points)
Information Technology	-0.9	-0.5	-0.4	0.2
Financials	-1.9	-1.3	-0.6	0.1
Healthcare	-1.9	-1.2	-0.7	0.1
Communications Services	-2.3	-1.9	-0.4	0.2
Real Estate	-2.6	-2.1	-0.5	1.0
Consumer Discretionary	-4.0	-1.5	-2.4	0.4
Consumer Staples	-8.3	-5.7	-2.6	0.0
Industrials	-9.2	-7.7	-1.5	0.1
Materials	-29.8	-23.5	-6.3	2.7
Utilities	-43.1	-37.8	-5.3	2.1
Energy	-45.5	-29.7	-15.8	4.3

(Note) Changes from the previous fiscal year are changes in CVaR for policy risks from the previous fiscal year calculated for the same model/scenario.
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Figure 3-16 Policy Risk: Domestic Corporate Bond Portfolio (%)

Sector	Policy Risk CVaR	Scope 1+2	Scope 3	Change from previous fiscal year (percentage points)
Financials	-0.1	0.0	0.0	0.0
Communications Services	-0.1	0.0	0.0	0.0
Real Estate	-0.1	-0.1	-0.1	0.0
Information Technology	-0.2	-0.1	-0.1	-0.1
Healthcare	-0.3	-0.2	-0.1	0.2
Consumer Staples	-1.1	-0.7	-0.4	-0.3
Consumer Discretionary	-2.1	-0.2	-1.8	0.3
Industrials	-2.3	-2.0	-0.4	-1.2
Materials	-17.1	-16.1	-0.9	5.3
Energy	-38.7	-17.4	-21.3	0.2
Utilities	-49.4	-47.5	-1.9	-1.2

(Note) Changes from the previous fiscal year are changes in CVaR for policy risks from the previous fiscal year calculated for the same model/scenario.
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Figure 3-17 Policy Risk: Foreign Corporate Bond Portfolio (%)

Sector	Policy Risk CVaR	Scope 1+2	Scope 3	Change from previous fiscal year (percentage points)
Financials	-0.1	0.0	0.0	0.0
Communications Services	-0.4	-0.4	-0.1	0.0
Real Estate	-0.1	-0.1	0.0	0.2
Information Technology	-0.1	0.0	0.0	0.0
Healthcare	-0.2	-0.1	0.0	0.1
Consumer Staples	-1.5	-1.2	-0.3	0.8
Consumer Discretionary	-1.5	-0.5	-1.0	0.2
Industrials	-1.9	-1.8	-0.1	1.9
Materials	-7.7	-6.8	-1.0	5.7
Energy	-9.9	-7.3	-2.6	-1.4
Utilities	-17.9	-17.3	-0.5	5.7

(Note) Changes from the previous fiscal year are changes in CVaR for policy risks from the previous fiscal year calculated for the same model/scenario.
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Physical Risks

Physical Risks CVaR

Finally, we conducted an analysis of the physical risks[1] in GPIF's portfolio. In the physical risk analysis, we examined potential deterioration in corporate revenues arising from asset damage and productivity declines caused by climate change-induced extreme weather events, such as floods and heat waves. We also analyzed the potential for increased revenues resulting from such extreme weather. For example, improvements in operating rates and reductions in heating costs in cold regions due to rising temperatures would represent positive results in the physical risk analysis.

This fiscal year, we added "river low flow[2]" and "wildfire" to the natural disasters included in the risk analysis. For "river low flow," we assumed that thermal power plants close to rivers and hydropower plants are exposed to the risk of falling river levels and, using a model for decreases in water volumes and accompanying power losses, calculated the change in costs. For "wildfire," we estimated factors such as weather conditions, probability of fires starting, probability of impact on specific locations, fire duration, and fire damage to assets to determine the wildfire risk to assets.

Further, this fiscal year, we trialed analyses based on multiple NGFS scenarios. Specifically, we used the four scenarios of Net Zero 2050, Below 2°C, Delayed Transition, and NDCs.

Physical Risks by Scenario

In this section, we first compared the risks of these four scenarios in terms of the damage from each type of natural disaster for each asset portfolio (Figures 3-18 to 3-21). The same trends were observed for all asset portfolios from almost all types of natural disaster, with no marked difference. However, we did find that the risks became smaller in the order of NDCs, Delayed Transition, Below 2°C, and Net Zero 2050. In other words, this suggests that the more initiatives progress to achieve high targets against climate change, the smaller the physical risks will be for each asset class in the portfolio.

[1] This section refers to "physical risks," but as stated in the main text, the positive and negative effects on corporate earnings have been offset.
[2] As of September 2022, there are reports of declining water levels in various regions of the world, including the Americas, Asia, and Europe. For example, the Rhine River, a major river in Europe, is also reported to drop in level, causing disruptions in ship navigation and river freight transportation, increasing transportation costs and concerns about the stable supply of goods.

Figure 3-18 Physical Risks by Scenario: Domestic Equity portfolio

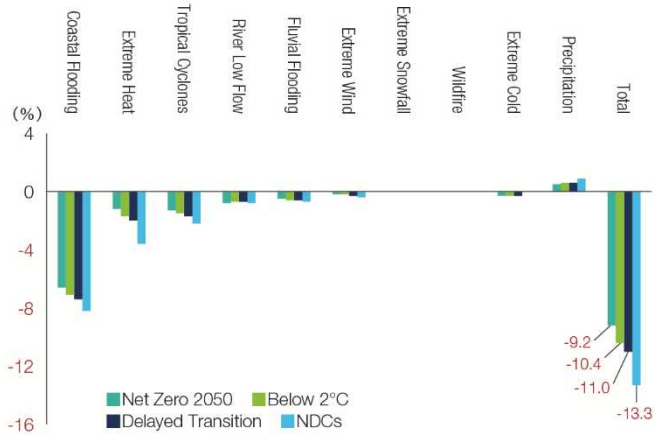

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Figure 3-19 Physical Risks by Scenario: Foreign Equity Portfolio

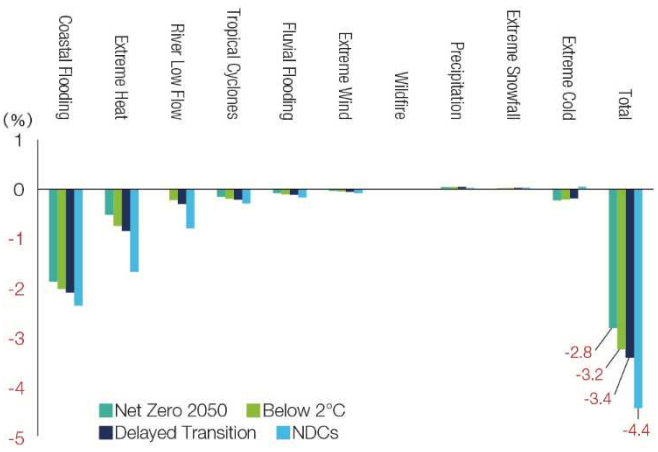

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Figure 3-20 Physical Risks by Scenario: Domestic Corporate Bond Portfolio

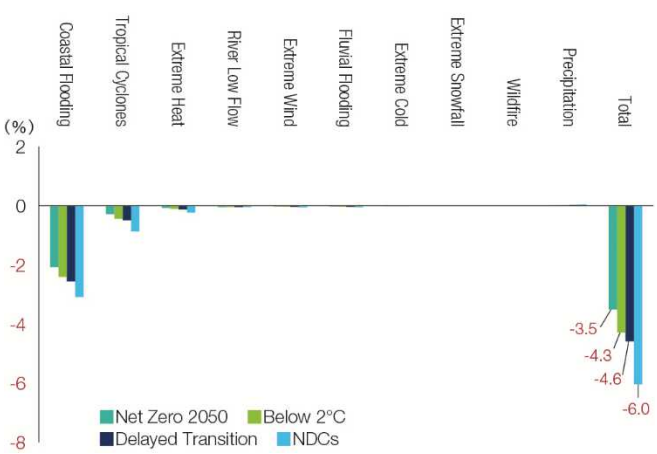

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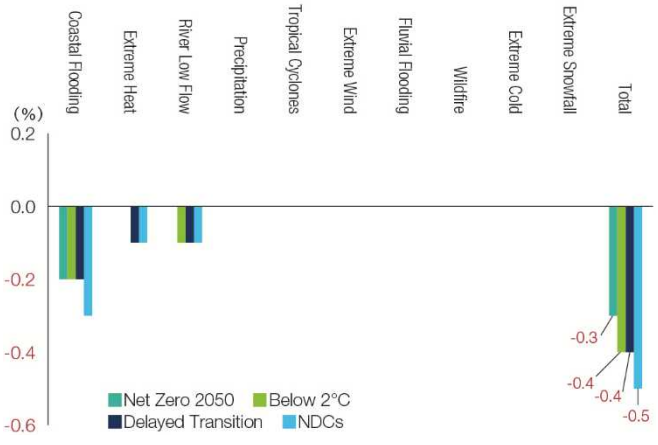
Figure 3-21 Physical Risks by Scenario: Foreign Corporate Bond Portfolio



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Physical Risks by Sectors

Next, we conducted an analysis of the physical risks in each portfolio asset class by sector based on the Net Zero 2050 scenario (Figures 3-22 to 3-25). As was the case in the previous fiscal year, the trends observed differed from policy risk trends. First, in the domestic equity portfolio, the utilities and energy sectors were shown to have significant physical risks in addition to policy risks, followed by the real estate sector. On the other hand, the risk in the financials sector, which was high in the previous fiscal year's analysis, has decreased due to an increase in the ratio of investment in companies with relatively low physical risks. In the foreign equity portfolio also, similar to the domestic equity portfolio,

the utilities, energy, and real estate sectors were shown to have high physical risks. The causes of these high risks are coastal flooding, tropical cyclones, and extreme heat. In the previous fiscal year's analysis, the risk of tropical cyclones was relatively small, but this fiscal year, we were able to assess the risks in a form that better approximates actual damage by updating the vulnerability factors in the tropical cyclone hazard model. For this reason, risks in the North American and Southeast Asian regions increased. Regarding coastal flooding as well, due to improvements in flood protection data, the risk models for urban areas and nonurban areas have been differentiated, but the impact of this was limited.

For domestic corporate bonds, risks were found to be highest in the utilities, energy, and materials sectors, while for foreign corporate bonds, the consumer staples, real estate, and consumer discretionary sectors had the highest risk. Overall, coastal flooding risk was high, while in the consumer staples sector of the foreign corporate bonds portfolio, the risk of precipitation was markedly high. For precipitation, a high risk coefficient was set for the retail industry, which is one constituent of the consumer staples sector. Thus, a relatively high weighting of the precipitation in this sector may be a factor behind this result.

Figure 3-22 Physical Risks by Sector: Domestic Equity portfolio

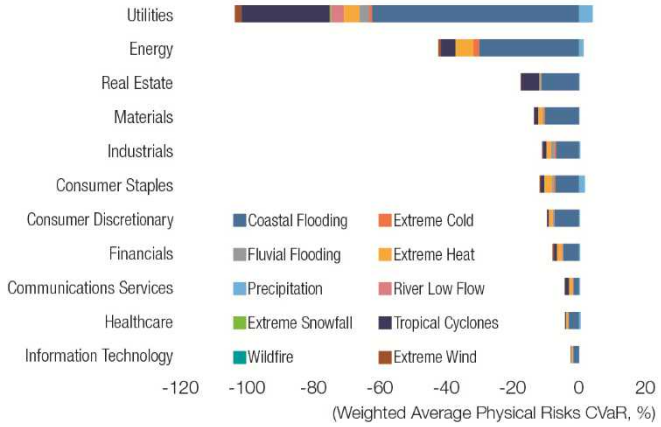

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Figure 3-23 Physical Risks by Sector: Foreign Equity Portfolio

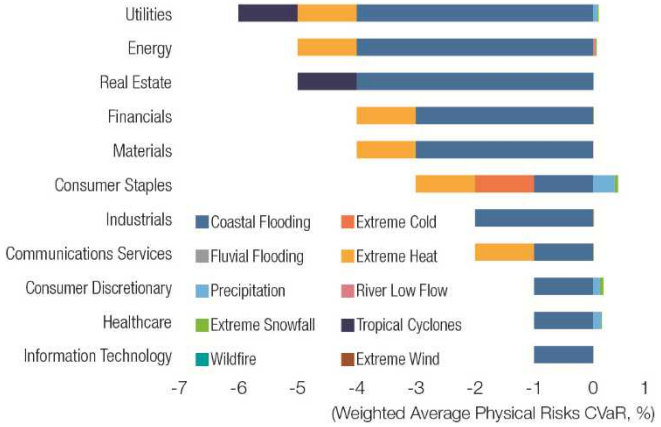

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Figure 3-24 Physical Risks by Sector: Domestic Corporate Bond Portfolio

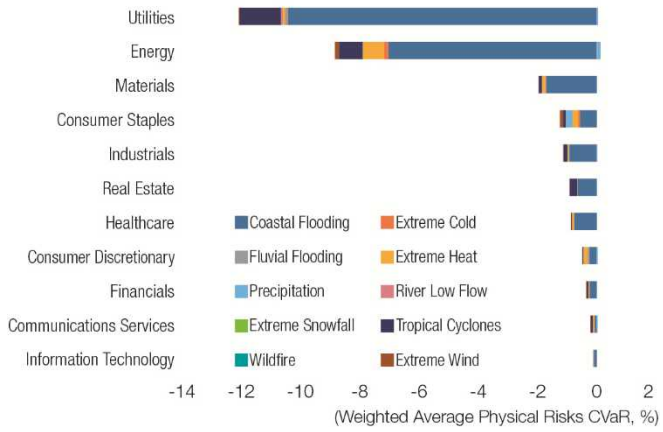

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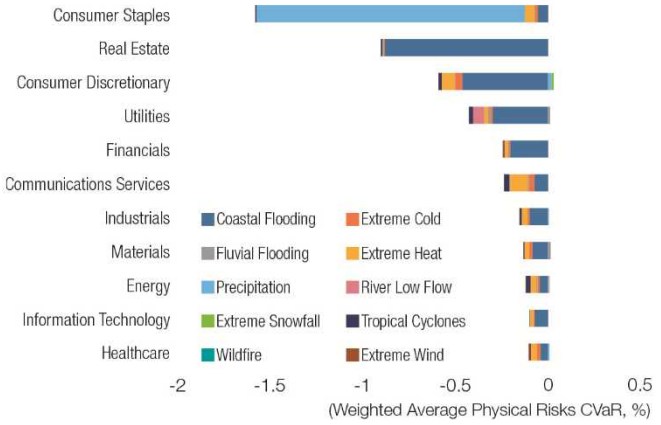
Figure 3-25 Physical Risks by Sector: Foreign Corporate Bond Portfolio



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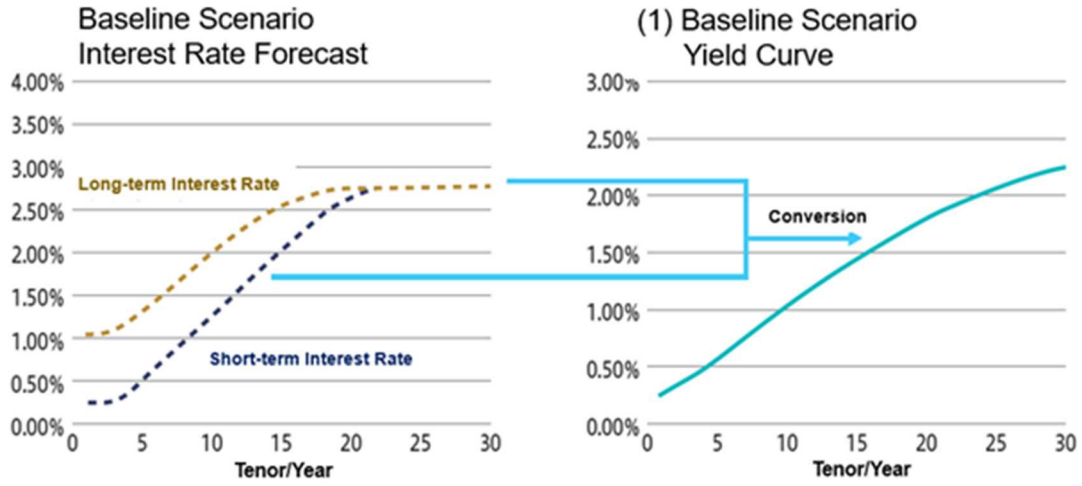
Analysis of Government Bond Portfolio Using Sovereign Bond Climate Value-at-Risk

Analysis of Government Bond Portfolio Using Sovereign Bond Climate Value-at-Risk

This section uses Sovereign Bond CVaR to analyze climate change risk to government bonds. This was done based on the question of how interest rates, which are a constituent of government bond prices, change in each of the various climate change response scenarios.

As an assumption to this analysis, we used the 30-year interest rate forecasts based on the NGFS framework and scenarios. Firstly, we produced (1) a 30-year yield curve to serve as the baseline scenario for the countries being analyzed, using the interest rate forecasts for the scenario that does not factor in the impact of climate change (Figure 3-26).

Figure 3-26 Conceptual Diagram of Calculation of CVaR of Government Bonds – (1) Baseline Scenario Yield Curve



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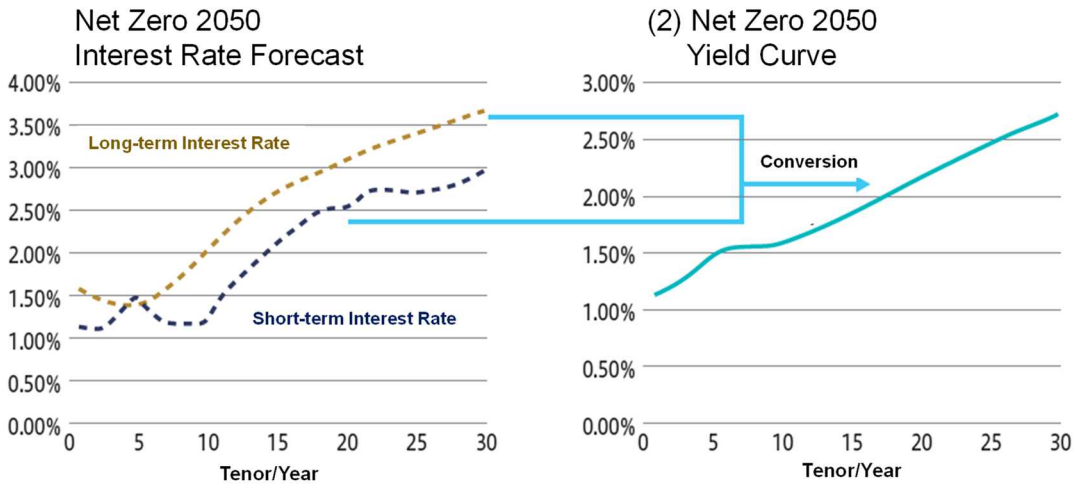
Next, we adopted five of NGFS's six climate scenarios, namely "Net Zero 2050," "Below 2°C," "Divergent Net Zero," "Delayed Transition," and "Nationally Determined Contributions (NDCs)" as the scenarios to be compared with the baseline scenario. We then produced (2) 30-year yield curves for each scenario for the countries being analyzed, using the same method as (1) (Figure 3-27).

Figure 3-27 Conceptual Diagram of Calculation of CVaR of Government Bonds – (2) Net Zero 2050 Yield Curve



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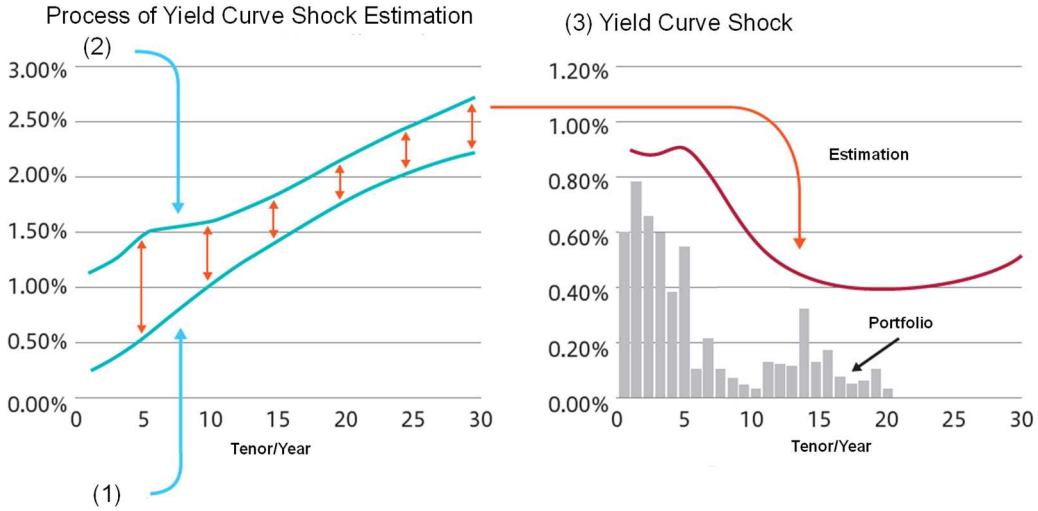
After that, comparing (1) and (2), we estimated (3) yield curve shock, which indicates how much the interest rate forecasts would change when transition from the base scenario to each individual scenario is assumed (Figure 3-28).

Figure 3-28 Conceptual Diagram of Calculation of CVaR of Government Bonds – (3) Yield Curve Shock



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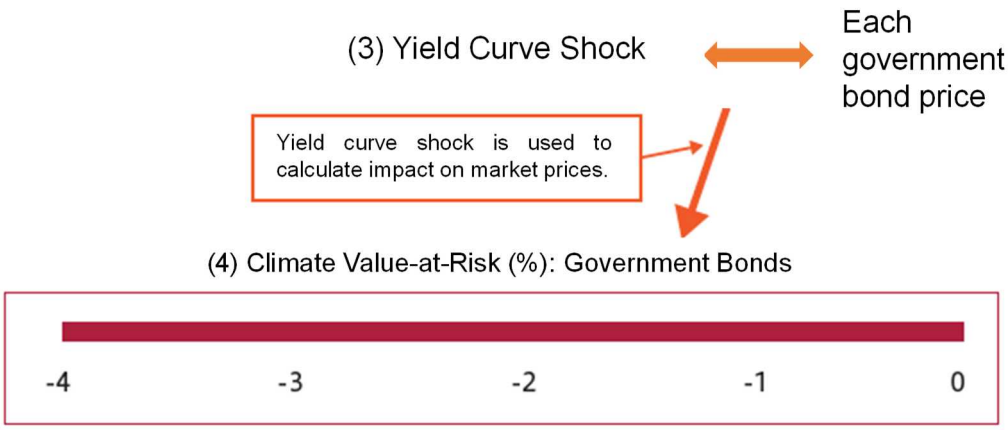
Next, using (3), we calculated (4) the price of the target countries' government bonds. Finally,

comparison of (4) with the current prices of the same bonds indicates to what extent returns will increase or decrease (Figure 3-29). It should be noted that, while the chronic impact of changes in climate patterns has been factored into physical risks in each scenario to a certain extent, acute impacts, such as disasters caused by extreme weather events, have not been taken into account.

Figure 3-29 Conceptual Diagram of Calculation of CVaR of Government Bonds – (4) Climate Value-at-Risk



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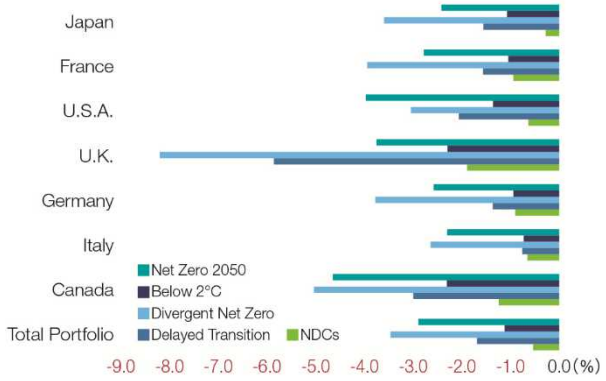
CVaR Analysis by Countries and Scenario

Using the analysis method described above, we calculated and compared CVaR by country for the government bond portfolio as of March 31, 2022 (Figure 3-30). The comparison was conducted across eight categories—Japan, France, United States, United Kingdom, Germany, Italy, Canada, and total portfolio. In the Net Zero 2050 scenario, the CVaR of Canada, United States, and United Kingdom was calculated at a relatively high level. In the Divergent Net Zero and Delayed Transition scenarios, the United Kingdom's CVaR was markedly high in relative terms, followed by that of Canada. However, government bond CVaR is affected by the duration of the investment in bonds held. In other words, if the size of the yield curve shock is the same, it is possible to say that the longer the duration of a government bond, the larger the negative CVaR impact will be. However, it should be noted that the price risk is generated by two factors, namely the duration of the government bond and the size of the yield shock at maturity (for example, in the Net Zero 2050 scenario, the yield curve shock is greater in the short term in some countries).

Figure 3-30 CVaR of Government Bonds by Countries



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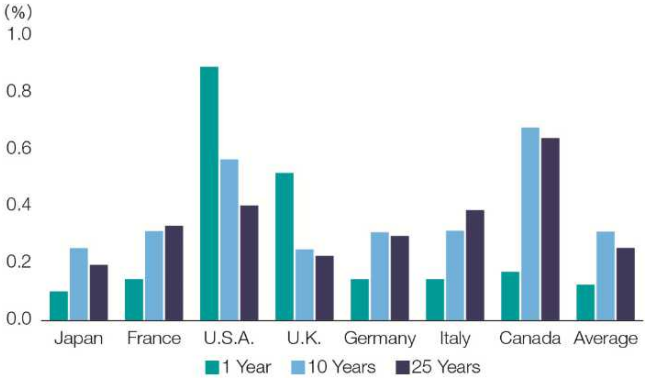
Country to Country Comparison Analysis of Yield Curb Shock and Rate of Decline in Government Bond Prices by countries

Based on the above perspective, we conducted a comparison of three yield curve shocks, namely for one year (short-term), ten years (long-term), and 25 years (ultra-long-term) until maturity under the Net Zero 2050 scenario (Figure 3-31). Because yield curve shock is estimated from the difference in interest rates between the baseline scenario and the climate scenarios, we can compare the difference in interest rates for individual years. In the United States, for cases of one year until maturity, the yield curve shock is relatively large. This is because, in the period of the Net Zero 2050 scenario, of which is close to the present day, it is envisaged that the U.S. inflation rate will become relatively high. A similar trend was observed for the United Kingdom. On the other hand, in the other countries, yield curve shock tended to be the lowest for one-year periods until maturity. In Japan, the yield curve shocks were smaller compared to the other countries.

Figure 3-31 Country-to-Country Comparison of Yield Curve Shock
(1-Year, 10-Year, and 25-Year Maturity)



(Note) The average is a simple average of 46 countries, including the above seven countries.
(Note) The analysis is based on "Net Zero 2050" scenario.
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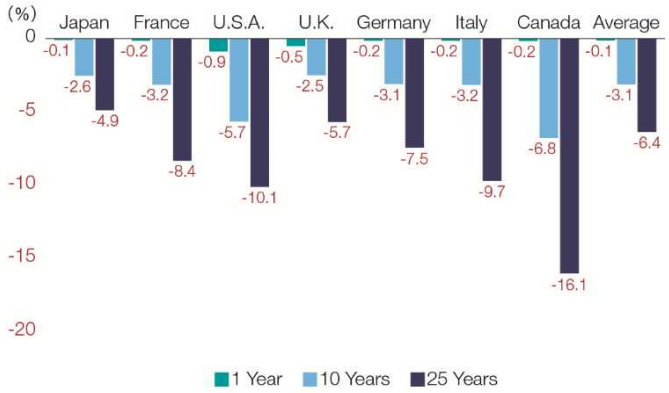
Next, we estimated the impact of yield curve shock on government bond prices (Figure 3-32). For convenience, we assumed zero-coupon bonds for each maturity period to approximate the impact of yield curve shock in the period until maturity and estimate the rate of decline in government bond prices. Figure 3-32 shows that the highest rate of decline was 16.1% in the price of 25-year Canadian government bonds. In this scenario, Canada had the greatest difference in interest rates over the 25 years until maturity. Longer discount periods are a factor in these results. From this simple simulation, it may be possible to summarize that, under specific climate scenarios, government bonds with longer maturity periods will be exposed to greater price risk.

Figure 3-32 Country-to-Country Comparison of Rate of Decline in Government Bond Prices (1-Year, 10-Year, and 25-Year Maturity)



(Note) The average is a simple average of 46 countries, including the above seven countries.
(Note) The analysis is based on "Net Zero 2050" scenario.
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(Appendix) CVaR: Methodology Descriptions

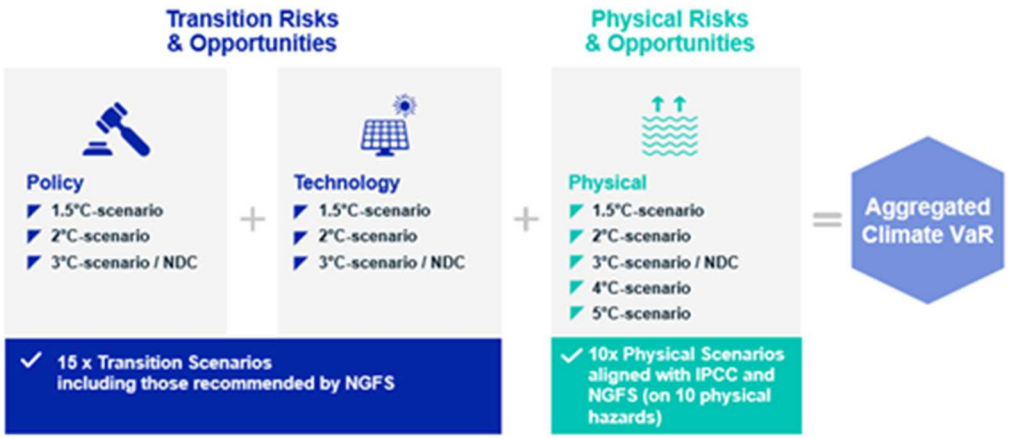
Characteristics of CvaR

MSCI's Climate Value-at-Risk (CVaR) is a valuation model that measures the potential impact of climate change on corporate and security values. CVaR measures the impact of future climate-related costs and revenue opportunities from low-carbon technologies on the value of a company and the securities it issues. Although there is still room for improvement in measurement methods, CVaR is an extremely innovative analytical method in that it can comprehensively assess the costs and opportunities of climate change in terms of its impact on corporate and security values based on financial theory. The following four steps are taken to measure the impact of climate change-related costs and revenue opportunities from low-carbon technologies on corporate equities and bonds:

Step 1: Estimate future climate change-related costs and profits
Step 2: Discount future climate change-related costs and profits to present value
Step 3: Estimate the impact on present corporate value (EV: Enterprise Value)
Step 4: Apportion the impact into impacts on equity and debt securities

CVaR has three main components: (1) Policy risk, (2) Technology opportunities, and (3) Physical risk, which are combined into aggregated CVaR (Figure 3-33). (1) and (2) together are categorized as "transition risks and opportunities," and can be evaluated as a whole with (3) physical risks. The following sections provide details on calculating CVaR for (1), (2) and (3) above.

Figure 3-33 Composition of Aggregated CVaR and Scenario Analysis Assumptions



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Climate Change Policy CVaR

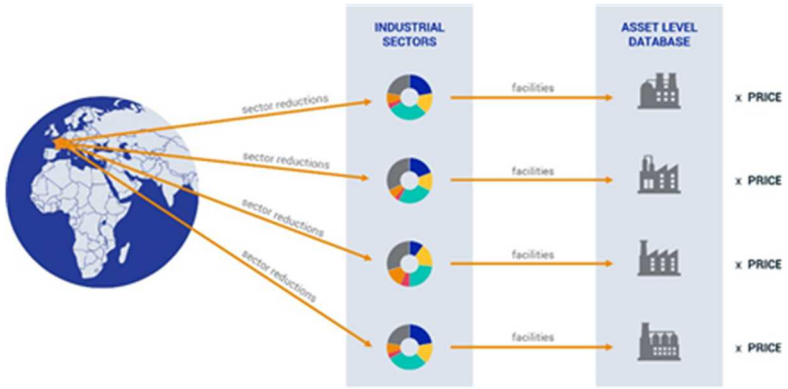
Policy CVaR estimates a company's costs associated with reaching emissions reduction targets under future climate change policies through the end of the 21st century. The Policy CVaR model analyzes the downside risk of climate policy to a company and its securities by estimating the future cost to that company of reducing emissions required to comply with these policies.

First, Policy CVaR analyzes the impact of national climate change-related regulations under scenarios of NGFS etc. by using national emissions reduction targets (Nationally Determined Contributions, commonly called NDCs) submitted under the Paris Agreement. These targets and regulations include Scope 1 GHG emissions, which are directly emitted from business activities, and Scopes 2 and 3 GHG emissions, which are indirectly emitted. The Scope 1 emissions analysis involves setting GHG emissions reduction targets at the national and sector level based on the country's NDC, and assigning emissions reduction requirements to companies operating in those sectors. The allocation is based on the "fair share" principle – i.e. each company is allocated a portion of the total required country and sector Scope 1 emission reduction according to the company's level of emissions. In other words, companies with a greater percentage of total emissions levels in their sector are required to reduce GHG emissions by a proportionally higher percentage.

In addition, company asset data is used to assign sector emission reduction targets to each company's facility level. This allows us to calculate emissions reduction requirements for facilities owned and operated by companies worldwide. By multiplying each company's demand for emission reductions by the future carbon price, we calculate the climate change policy cost that each company would have to pay to achieve its emission reduction target (reduction requirement) (Figure 3-34).

A portion of this climate change policy cost is modeled to pass through to customers and suppliers within a company's value chain as discussed below. Incidentally, the carbon price is determined using the integrated assessment model and depends on the selected policy scenario (e.g. 1.5°C, 2°C, 3°C etc.).

Figure 3-34 Image of Scope-1 Emissions Analytical Models for Policy CVaR



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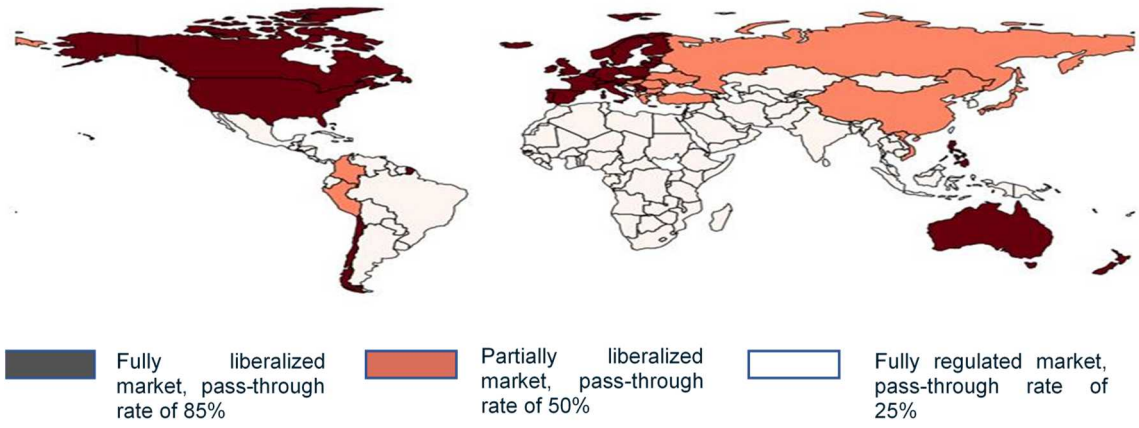
The scope 2 emissions analysis calculates the costs incurred by power producers that are passed on to consumers (Figure 3-35). The transition to a low-carbon economy requires switching electricity sources from coal and natural gas to lower carbon or GHG emissions-free sources. However, this transition can be costly. For electric power companies, phasing out fossil-fuel-based thermal power plants and shifting to low-carbon power sources leads to increased capital expenditures. These include decommissioning aging power plants, introducing new technologies, and upgrading power grids to ensure supply from new power sources. Electric power companies do not bear all these costs – some are passed on to electricity consumers. The potential cost associated with electricity consumption for each transition scenario is calculated from data on electricity production and consumption generated by the Integrated Assessment Model and estimates of cost passthrough rates to consumers. For example, in regions where the electricity market is fully liberalized, power producers are expected to pass on 85% of their costs to end consumers. We assume a pass-through rate of 50% for partially liberalized regions and 25% for fully regulated regions.

Figure 3-35 Pass Through Rates of Scope 2 Emissions from the Policy CVaR



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The Scope 3 emissions analysis examines each company's potential carbon-related costs within the value chain, as determined by the size of the company's Scope 3 emissions. By combining Scope 3 carbon-related costs with assumed burden rates, we estimate the impact on the costs that companies will incur from GHG emissions occurring in the value chain. The assumed burden rate represents the level of costs that a company may bear depending on the amount of GHGs emitted from the value chain, which stem from 15 upstream and downstream categories as defined by the GHG protocol. The CVaR analyses also distinguish between upstream and downstream categories. For example, by analyzing upstream GHG emissions, we assess the risk that companies' procurement costs for materials and other items will increase. The downstream GHG emissions analysis, on the other hand, examines the risk that a company's market share will be lost due to changes in demand. By evaluating

upstream and downstream GHG emissions independently, we calculate a company's "value chain (scope 3) CVaR" and included this in the company's policy risk evaluation. The assumed burden rates applied to distinguish the upstream and downstream impacts of the value chain are as follows (Figure 3-36).

- **Scope 3 Upstream Burden Rate:**
  Upstream Burden Rate represents the percentage of costs that are passed through from companies upstream in the value chain to companies being evaluated. If countries implement climate change policies aimed at reducing GHG emissions, companies may need to shift to less-emitting production technologies and product development, and if this is not possible, they may face the risk of paying fines and taxes. This could lead to increased capital and operating expenditures to comply with climate change policies, which in turn could increase a company's marginal cost of production. Competitiveness in a company's product markets and how efficiently a company can internalize its costs affect analysis of how much the company can pass on its climate costs to its customers.

- **Scope 3 Downstream Burden Rate:**
  Downstream Burden Rate is the percentage of costs that a company must absorb as market demand for its products has been affected. In a low carbon economy transition scenario, it is anticipated that the implementation of regulations aimed at reducing GHG emissions will result in weak market demand for high GHG emission products and a shift in market demand from low carbon products to zero emission products. This means that demand for its products may decline sharply in a particular sector. The assumed burden ratio varies depending on the price elasticity of demand and the substitutability of the product.

Figure 3-36 Examples of Scope 3 Emissions Burden Rates in the Policy CVaR

Scope 3 Category		Assumed Burden Rate	Rationale	Supporting Research
Default Burden Rate		45%	Research suggests an overall low burden rate for industry.	Nuehoff & Ritz (2019) MSCI ESG Research estimate
4 + 9	Upstream and downstream transportation	100%	High burden rate as extra costs from transportation are typically passed on to a high degree because of low profit margins.	MSCI ESG Research estimate
6	Business travel	78%	Research suggests a rather high burden rate for some of the major business transportation means such as air travel.	Grey & Ritz (2018)
7	Employee commuting	0%	No burden on companies, assumes costs are absorbed by employees.	MSCI ESG Research estimate
11	Use of sold products	Sector specific	Burden rates depend on several sector specific factors such as: • Price elasticities of demand • Depth of supply chain • Sector competitivity	Droege (2013) Ganapati et al. (2019) MSCI ESG Research estimate
	• Consumer Discretionary	60%		
	• Energy	55%		
	• Materials	10%		
15	Investments	5%	Weak impact of investor costs on market capitalization leads to a low burden rate.	MSCI ESG Research estimate

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Measures Against Double Counting

Given that GHG emissions from Scope 3 are an important factor in institutional investors' climate risk management, we need to consider the issue of double counting of GHG emissions. Double counting for GHG emissions refers to counting the same emissions more than once. For example, the Scope 1 GHG emissions for one company can be counted as another company's Scope 3 emissions. This occurs primarily when a company's comprehensive carbon footprint (scopes 1, 2, and 3) is aggregated within its investment portfolio. Even if companies in the same value chain calculate and report the same emissions, the reasons for double counting differ. For example, oil mining companies should report GHG emissions generated when fuel products sold are burned, while car companies should include emissions from the combustion of the same fuel in reporting GHG emissions generated when vehicles sold are used. Some fossil fuel refining companies also perform similar calculations and reports. In most cases, model estimates are available without problems, but the inclusion of double counting may be a barrier. We recognize that it is not possible to completely eliminate duplication from Scope 3 emissions even in CVaR analyses. The most difficult issue is that individual companies may have significantly different levels of double counting.

Despite these barriers of double counting, pressure is increasing to fully understand the upstream and downstream climate risks of the investment portfolio. In CVaR analyses, we use deduplication factors to reduce the impact of double counting. With regard to the calculation of the deduplication factors, at first, in order to determine the double counting at the macro level, we calculated the total GHG emissions of the largest group of enterprises (10,000 or more enterprises) with both Scope 1 GHG emissions and Scope 3 GHG emissions data points for each scope and determined their relationship. Assuming that the GHG emissions for these two data sets are within a limited closed environment, the relationship between the data points can be regarded as an approximation of the double counting that occurred. All Scope 3 emissions at any point in time are considered to have been Scope 1 emissions by other companies. CVaR models calculate deduplication factors from these relationships and apply them to the analyses.

Image of the Estimated Burden Rate of Scope 3 Emissions from the Climate-Change Policy-Risk CVaR is as follow (Figure 3-37).

Figure 3-37 Image of the Estimated Burden Rate of Scope 3 Emissions from the Climate-Change Policy-Risk CVaR

Number of companies	10,881
Sum of Scope 1 total emissions	15,028 MtCO2 / year
Sum of Scope 3 total emissions	68,080 MtCO2 / year
Deduplication Factor	~0.22

(Note) This deduplication factor is illustrative and may not be the actual factor used to compute CVaR.
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Low-carbon Technology Opportunities CVaR

The Low Carbon Technology Opportunities CVaR calculates the profits a company generates in the future from low carbon technologies based on an assessment of the status of companies' acquisitions of low carbon technology patents and current low carbon technology-related revenues. This patent analysis covers approximately 100 million corporate patent data from more than 70 patent authorities worldwide. Assessing the quality of low-carbon patents classified in more than 400 groups and using that assessment as an alternative indicator of an enterprise's innovative capacity, this model aims to analyze which companies are likely to generate profits and gain growth opportunities from low-carbon technologies when policies related to climate change are implemented globally at the 3°C, 2°C, or 1.5°C levels. This Low Carbon Technology Opportunities CVaR works to boost corporate value and security value as a factor in contrast to the impact of the costs of climate change policies (the cost of reducing carbon emissions) that arise as a result of the transition to a low-carbon society.

Because not all patents have equal value, the number of patents alone cannot predict a company's innovative capabilities or future market growth potential. The Low-Carbon Technology Opportunities CVaR calculates patent scores based on four statistical measures established in academic literature and by practitioners (Figure 3-38).

Profits from each company's environmental technologies are calculated by allocating future environmental revenues for each sector by the share of patent scores within the sector, and multiplying the allocated revenues by the sector average profit margin. At this time, we assume that the size of the sector's future revenues from environmental technologies is equal to the sector-level climate change policy costs (the cost of reducing carbon emissions) calculated under the Climate Change Policy Risk CVaR. This is because we assume that if the cost of reducing carbon emissions is incurred, the potential revenues from selling low-carbon technologies are equal.

Figure 3-38 Four Statistical Measures in the Calculation of Patent Scores

Forward citations	The number of references to the patent in other patent applications. This is a measure of the widespread acceptance of the value or significance of a patent. If a patent is frequently cited by other patent applications, the patents frequently cited are likely to befundamental technologies or important technology patents.
Backward citations	The number of patents of others cited at the time of filing of the patent application. A larger number of backward citations reduces the patent value because it is likely to beolder and based on more established technology.
Market Coverage	The total GDP of the country in which the patent to be evaluated was filed. The higher the market coverage, the higher the patent score.
CPC coverage	Number of tagged CPC patent groups. Cooperative Patent Classification (CPC) evaluates the relevance of patents to patent groups based on the International Patent Classification. The more groups tagged in this relevance assessment, the higher the patent score.

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Physical Risks CvaR

The physical Risk CVaR analyzes the financial impact of acute and chronic extreme weather events expected to occur by the end of the century on companies, based on climate data from observations and the latest climate model projections. Physical risk impacts are calculated at the regional, sectoral, and corporate level.

The Physical Risk CVaR estimates the physical risk at the company’s facility level under selected scenario conditions (average or aggressive scenario) for three factors: "exposure (assessment based on the location, size, type, and value of the enterprise's assets)", "hazards (probabilities and severity of extreme weather events)", and "vulnerability (the propensity or predisposition of an asset to be affected)".

The physical risk CVaR is currently classified into two types of risk (chronic risk and acute risk). The following eight types of extreme weather events are the scope of the Physical Risk CVaR Analysis, with the addition of the Low River Flow and Wildfires in this fiscal year (Figure 3-39).

Figure 3-39 Natural Disasters Subject to Analysis of Physical Risks CVaR

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- **Newly added hazard type: River low flow**

  We assess the economic impact of river low flow, i.e., water scarcity on the power production sector, specifically on thermal and hydro power plants, which rely implicitly on large amounts of water. Here, it is assumed that all thermal power plants located within 10 km of a river and all hydropower plants are exposed to river low flow risk.

- **Newly added hazard type: Wildfire**

  Climate change has been a key driver in creating warmer and drier weather conditions that are ideal for the development of wildfires. To determine wildfire risk to an asset, we estimate five components:

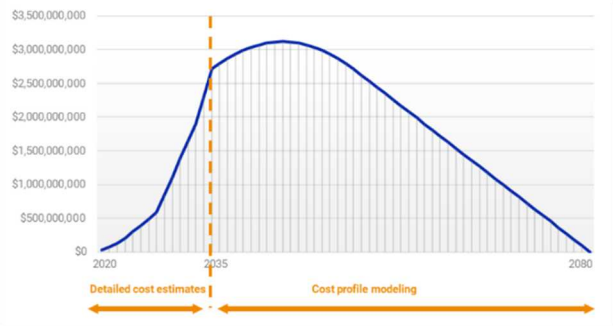
  1. Fire weather: occurrence of weather conditions favorable to wildfire occurrence.
  2. Fire ignition: the probability of wildfire starting given favorable weather conditions.
  3. Fire spread: the probability of wildfire affecting a particular location given an ignition in the vicinity.
  4. Fire intensity: duration of a wildfire once one starts.
  5. Fire vulnerability: relative damage sustained by assets affected by wildfires combined with business interruption

Financial Models that Reflect Climate Change Risks and Opportunities in Security Values

As noted earlier, CVaR estimates follow four steps. In Step 1, we estimate future climate-related costs and profits, and the analyses will take a different approach over the next 15 years and beyond. For the first 15 years, we estimate in detail climate change policy risks, profits from low carbon technologies, business losses and facility damage due to extreme weather. From the 16th year onward, we estimate costs through 2080 using the model.

The model estimates that climate change policy costs and profits from low-carbon technologies will peak in the next 25 years and then decrease linearly to 0 by 2080 (Figure 3-40). On the other hand, actual climate change, such as global warming, is expected to have a longer-term impact. So, physical risks analyze by using extreme weather events data based on climate model by 2100.

Figure 3-40 Estimation Methods and Image of Climate Change Policy Costs and Low-Carbon Technologies Profits



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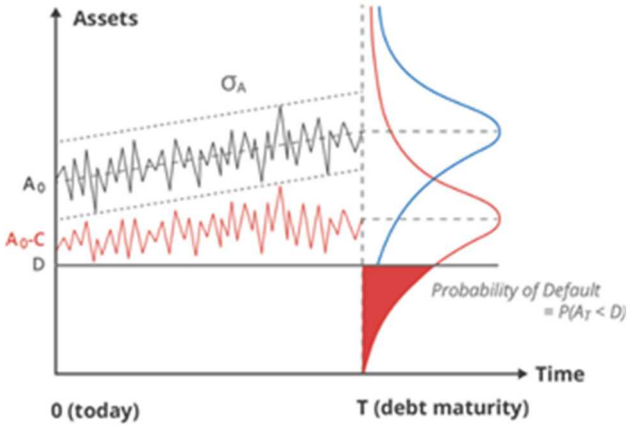
Step 2 is to discount costs and profits calculated under Step 1 using the weighted-average cost of capital (WACC). The model assumes that the discount rate used for the first year is equal to a company's WACC and over time the rate converges to the sector average WACC by 2080.

Step 3 calculates CVaR of the company, which is the present value of the costs and profits calculated in previous step divided by the enterprise value (EV:). The value implies the impact of climate change-related costs and profits on enterprise value[1].

Finally, Step 4 divides the company-level CVaR into its equity and debt securities. In this step, CVaR for debt securities is determined by the Merton model to estimate the change in the probability of the company's default resulting from climate-change-related costs and profits (Figure 3-41). Equity CVaR is then calculated using the company's aggregated CVaR and CVaR for debt securities.

[1] It is assumed that the current enterprise value does not incorporate the climate change-related costs and benefits that are being analyzed.

Figure 3-41 Image of the Merton Model



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Chapter4: Other Analysis

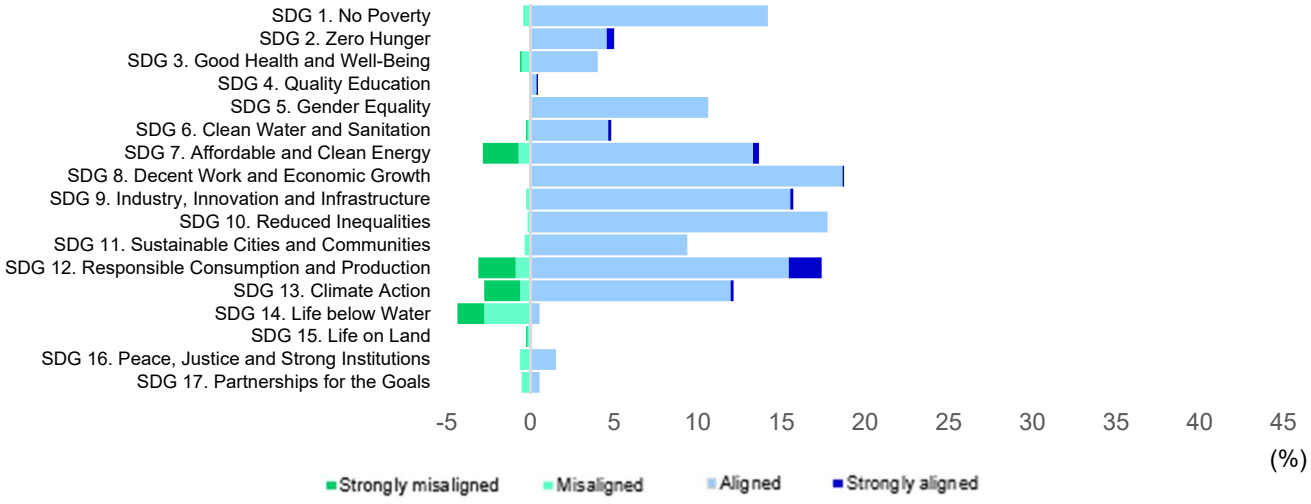
Evaluation of Alignment with SDGs

SDG Alignment

In previous sections, we analyzed the risks and opportunities in the context of climate change, but this section expands the discussion beyond climate change by evaluating the extent to which GPIF's equity portfolio are aligned with the 17 Sustainable Development Goals (SDGs) defined by the United Nations.

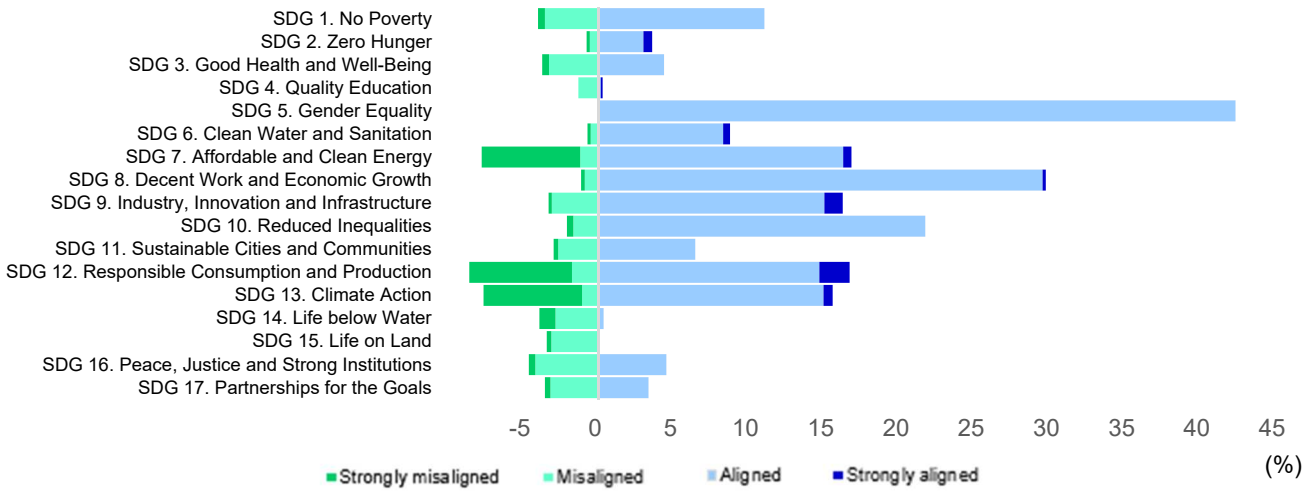
Alignment with the SDGs in this section is evaluated for each constituent company based on MSCI's SDG Alignment data. Specifically, four elements of each constituent company are identified, namely, the positive and negative impacts of their products and services and the positive and negative impacts of their business activities on each of the SDGs. These results are then totaled, and those impacts are given a score from -10 to +10. Further, the companies are then assessed in five categories -"strongly aligned," "aligned," "neutral," "misaligned," and "strongly misaligned" depending on their score. Based on the results of the analysis and total obtained with the method described above, the extent to which the constituent companies of GPIF's domestic equity and foreign equity portfolios correspond to each category (excluding "neutral") is indicated for each individual SDG (Figures 4-1 and 4-2).

Figure 4-1 Evaluation of Alignment with SDGs: Domestic Equity Portfolio



(Note) "Strongly misaligned" and "Misaligned" are presented as minus.
(Source) GPIF, Reproduced by permission of MSCI ESG Research LLC ©2022.

Figure 4-2 Evaluation of Alignment with SDGs: Foreign Equity Portfolio



(Note) "Strongly misaligned" and "Misaligned" are presented as minus.
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A comparison of these SDG alignment results revealed a number of distinctive characteristics for each goal. Firstly, the percentage of companies that are "aligned" with SDG 5: Gender Equality was approximately 42% for constituent companies in the foreign equity portfolio, a significantly higher percentage than the approximately 11% of the constituent companies in the domestic equity portfolio. This is believed to reflect the proactive gender equality initiatives being pursued by overseas companies. Similarly, the percentage of companies that are "aligned" with SDG 8: Decent Work and Economic Growth was approximately 30% for constituent companies in the foreign equity portfolio, much higher than the approximately 19% of the constituent companies in the domestic equity portfolio.

Further, when the percentages of companies categorized as "aligned" and "strongly aligned" with the other goals are combined, those percentages tended to be lower for the constituent companies in the domestic equity portfolio than those in the foreign equity portfolio. On the other hand, when the percentages of companies categorized as "misaligned" and "strongly unaligned," for many of the goals, those percentages tended to be lower for the constituent companies in the domestic equity portfolio than those in the foreign equity portfolio.

Many of the companies in both the domestic and foreign portfolios were categorized as "neutral," a trend that was particularly prevalent among Japanese companies. This could be interpreted as there being plenty of room for these companies to align with the SDGs as they move forward with their initiatives.

Economic Impact of Corporate Activities on Individual SDGs

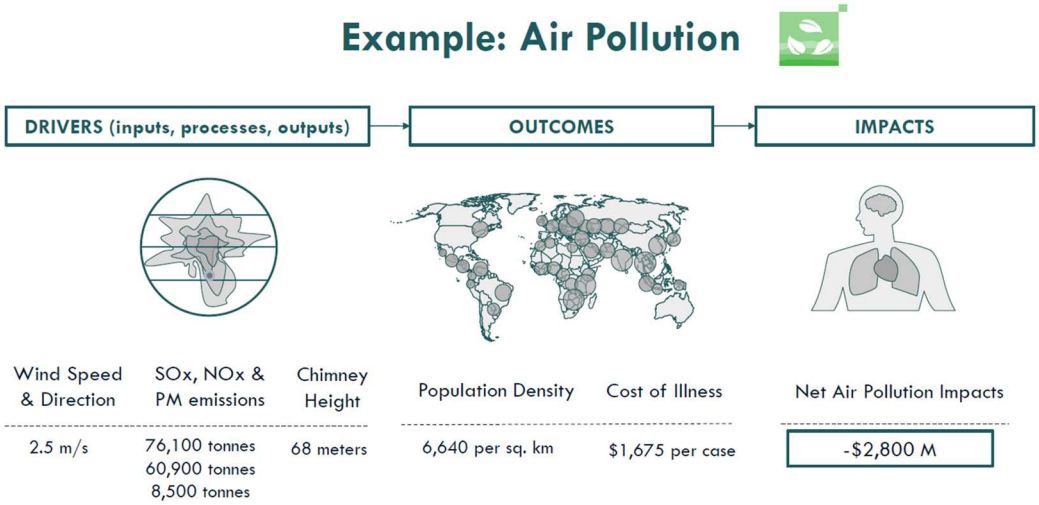
Trial of Economic Evaluation of Impact on Corporate Activities

This section evaluated companies from the perspective of alignment with SDGs. All investors, including GPIF, want to measure the impact of companies' activities on the individual SDGs ("SDGs impact") using a financial scale. Various attempts have been made to propose solutions to these needs, but at present, partly due to the small number of target companies, there are still many challenges in verifying trends in the overall portfolio. Accordingly, in this report, instead of evaluating the total portfolio, we present a brief introduction of some challenging initiatives that are currently being undertaken.

The analysis of SDGs impact totals the economic impact in three categories, namely natural capital, human capital, and produced capital. For example, natural capital consists of factors such as GHG emissions and atmospheric pollution.

Because the targeted data differs for each constituent factor, the specific calculation method is explained using "atmospheric pollution" as an example. Firstly, we output the data that will form the foundation of the evaluation, such as wind speed and direction and atmospheric pollutants such as sulfur oxides. Next, we add in data such as population density and the costs of atmospheric pollution-related illness and calculate the financial impact of atmospheric pollution from that company's business (Figure 4-3).

Figure 4-3 Example: Air Pollution



(Note) Numbers shown are for illustrative purposes only.
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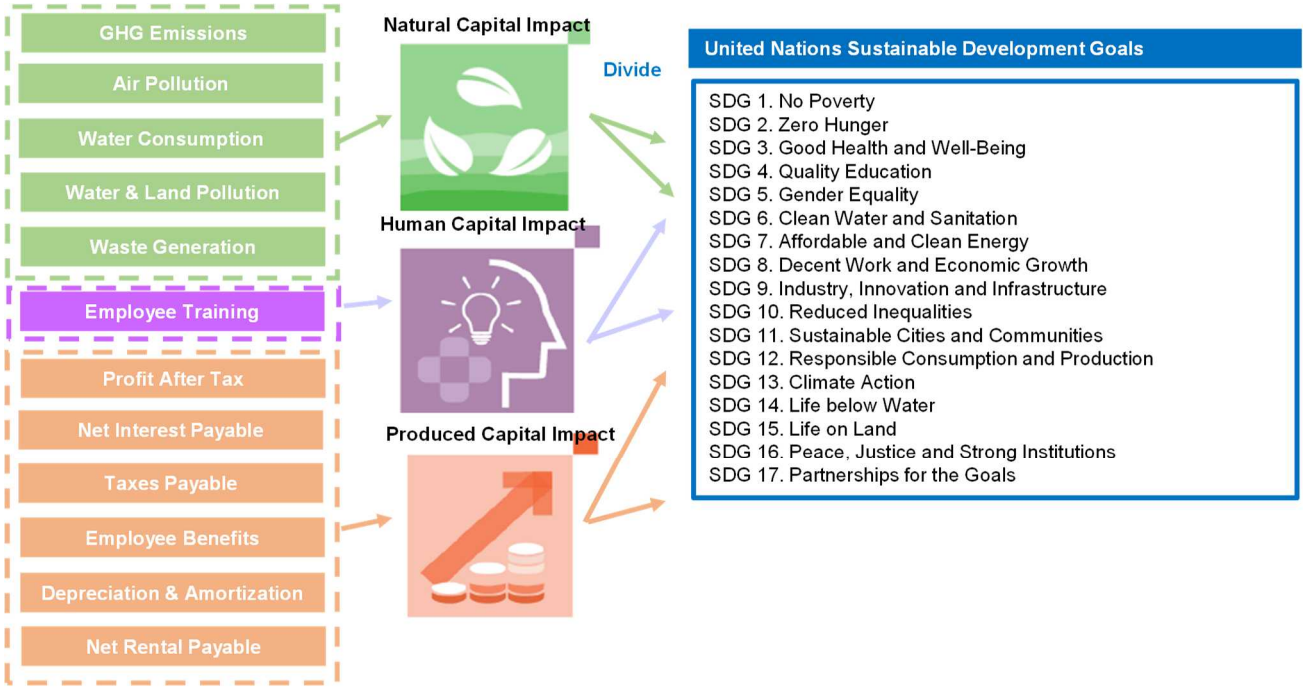
From the economic impacts of each constituent element, the economic impact of natural capital is calculated and distributed proportionally to each of the relevant SDGs. For example, the economic impact of natural capital is distributed among the relevant SDGs from among Goals 3, 6, and 11-15 (Figure 4-4).

Figure 4-4 SDGs Impact Image



(Note) Translation layer of the Capital Impacts to SDG goals showcased using arrows are for illustrative purposes only.
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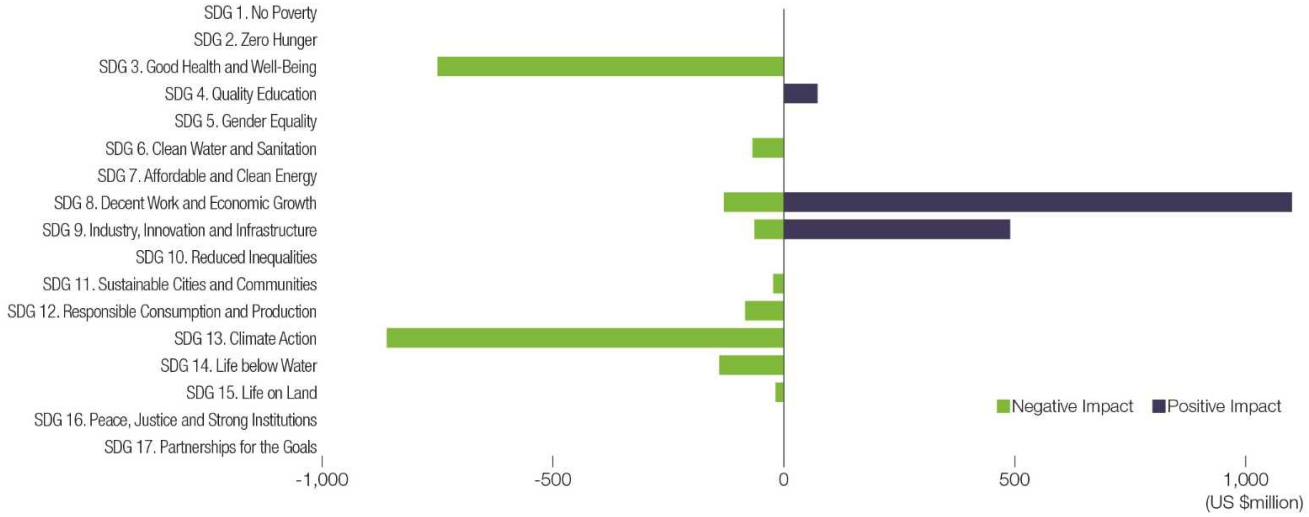
Positive/Negative Impact of Corporate Activities

The following is the example of one company's economic impact. The positive impact and negative impact are shown for each of the SDGs (Figure 4-5). For this company, both positive and negative impacts on "SDG 8. Decent Work and Economic Growth" and "SDG 9. Industry, Innovation and Infrastructure" are estimated.

These results suggest that corporate activities do not necessarily have only either a positive or negative impact on the SDGs. As mentioned at the top of this column, we are not yet at the stage of being able to use this information in analysis on a large scale, such as for the total GPIF portfolio. However, there are hints to be obtained from the examples of individual companies, and the calculation of the relationship between the SDGs and companies in the form of economic impact is an initiative that we hope to watch closely going forward.

Figure 4-5 SDG Impact by Goal



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Analysis of Businesses Contributing to Climate Change Action

About Green Revenues Classification System

As described in “Public- and Private-Sector Support for Achieving a Net-Zero Economy” progress is being made on companies’ climate action initiatives. In evaluating companies’ initiatives, it is important to identify the extent to which companies’ business activities are contributing to the transition to a green economy including climate action.

FTSE Russell defines revenues from green businesses that contribute to climate action as “green revenues” and uses its Green Revenues Classification System to measure such revenues of listed companies. This system classifies business activities that fall under green revenues into ten green sectors (Energy Generation, Environmental Resources, Transport Equipment, Food & Agriculture, etc.) and further classifies them into 64 sub-sectors and 133 micro-sectors. It also evaluates the degree of positive impact of companies’ business activities on the environment at the micro-sector level and grades them as Tier 1, Tier 2, and Tier 3, with Tier 1 having the most positive impact. The relationship between each of these sectors and Tiers is shown in Figure 4-6 to Figure 4-15.Figure 4-Figure 4

For example, in Energy Generation sector, wind and solar power are classified as Tier 1 activities, defined as having the clearest, most marked benefit on the environment. Meanwhile, biogas is classified as a Tier 2 activity, defined as having a positive environmental impact, albeit a more limited one than Tier 1. Tier 3 activities, which include nuclear power, are considered to be neutral overall, in that their environmental benefits are potentially accompanied by material environmental risks (Figure4-6). Fossil Fuels (general) is not classified as green revenue.

In addition, Trains (Electric/Magnetic) in Transportation Equipment sector are classified as Tier 1, while Aviation (General) is classified in Tier 2 (Figure 4-7). In Environmental Support & Services sector, the revenue of activity related to sustainable finance, such as Carbon Credit trading and Sustainable Investment Funds are classified as Tier 2 (Figure 4-13). In Energy Management & Efficiency sector, Smart & Efficient Grids (general), Power Storages, and Industrial Processes (general) are classified as Tier 1, and Cloud Computing is classified as Tier 2 (Figure 4-14). These mainly include activities that contribute to the efficiency of energy use. In Waste & Pollution Control sector, Tier 1 classifies Particles & Emission Reduction Devices and Recycling Equipment are classified as Tier 1 and Environmental Testing & Gas Sensors (General) are classified Tier 2 (Figure 4-15).

Figure 4-6 Green Revenue Classification in Energy Generation Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Energy Generation	Bio Fuels	Bio Fuels (General)	TIER 3
		Bio Gas	TIER 2
		Bio Mass (Grown)	TIER 3
		Bio Mass (Waste)	TIER 2
	Cogeneration	Cogeneration (General)	TIER 2
		Cogeneration (Biomass)	TIER 1
		Cogeneration (Renewable)	TIER 1
		Cogeneration (Gas)	TIER 2
	Fossil Fuels	Fossil Fuels (General)	-
		Clean Fossil Fuels	TIER 1
	Geothermal	Geothermal	TIER 1
	Hydro	Hydro (General)	TIER 2
		Large Hydro	TIER 2
		Small Hydro	TIER 1
	Nuclear	Nuclear (General)	TIER 3
	Ocean & Tidal	Ocean & Tidal (General)	TIER 1
	Solar	Solar (General)	TIER 1
	Waste to Energy	Waste to Energy (General)	TIER 1
	Wind	Wind (General)	TIER 1

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-7 Green Revenue Classification in Transport Equipment Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Transport Equipment	Aviation	Aviation (General)	TIER 2
	Railways	Railways (General)	TIER 2
		Railway (Infrastructure)	TIER 1
		Trains (Electric / Magnetic)	TIER 1
		Trains (General)	TIER 2
	Road Vehicles	Road Vehicles (General)*1	TIER 1
		Advanced Vehicle Batteries	TIER 1
		Bikes and Bicycles	TIER 1
		Bus and Coach Manufacturers	TIER 1
		Electrified Road Vehicles*2*3 & Devices (inc Hydrogen powered)	TIER 1
		Energy Use Reduction Devices	TIER 1
	Shipping	Shipping (General)	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
*1 Road Vehicles (General): Includes vehicles and parts that have a low environmental impact.
*2 Electrification vehicles: This includes electric vehicles, fuel-cell vehicles, plug-in hybrid vehicles, hybrid vehicles (mild hybrids are excluded), etc.
*3 The strong hybrid vehicle is a hybrid vehicle that can travel long distances using only electric power without using an internal combustion engine (reducing transport emissions). The main power is an electric battery, and the internal combustion engine is positioned as a backup. The main power of a mild hybrid vehicle is an internal combustion engine, and the electric battery is positioned as a backup. (Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-8 Green Revenue Classification in Energy Equipment Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Energy Equipment	Bio Fuels	Bio Fuels (General)	TIER 3
		Bio Fuel (1st & 2nd Generation)	TIER 3
		Bio Fuel (3rd Generation)	TIER 3
		Bio Gas	TIER 2
		Bio Mass (grown)	TIER 3
		Bio Mass (waste)	TIER 2
	Cogeneration Equipment	Cogeneration Equipment (General)	TIER 2
		Cogeneration (Biomass)	TIER 1
		Cogeneration (Renewable)	TIER 1
		Cogeneration (Gas)	TIER 2
	Fossil Fuels (Integrated)	Fossil Fuels (Integrated) (General)	-
		Carbon Capture & Storage	TIER 1
	Fuel Cells	Fuel Cells	TIER 2
	Geothermal	Geothermal	TIER 1
	Hydro	Hydro (General)	TIER 2
		Large Hydro	TIER 2
		Small Hydro	TIER 1
	Nuclear	Nuclear (General)	TIER 3
	Ocean & Tidal	Ocean & Tidal (General)	TIER 1
	Solar	Solar (General)	TIER 1
	Waste to Energy	Waste to Energy (General)	TIER 1
	Wind	Wind (General)	TIER 1

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-9 Green Revenue Classification in Food & Agriculture Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Food & Agriculture	Agriculture	Agriculture (General)	TIER 3
		GM Agriculture	TIER 3
		Machinery	TIER 1
		Meat & Dairy Alternatives	TIER 1
		Non GM Advanced Seeds	TIER 2
		Organic & Low-Impact Farming	TIER 1
	Aquaculture	Aquaculture (General)	TIER 3
		Aquaculture (Conventional)	TIER 3
		Aquaculture (Sustainable)	TIER 1
	Land Erosion	Land Erosion (General)	TIER 1
	Logistics	Logistics (General)	TIER 1
	Food Safety, Efficient Processing & Sustainable Packaging	Food Safety, Efficient Processing & Sustainable Packaging (General)	TIER 3
		Food Safety, Efficient Processing & Sustainable Packaging (no single use plastic)	TIER 1
		Food Safety, Efficient Processing & Sustainable Packaging (with single use plastic)	TIER 3
	Sustainable Plantations	Sustainable Planations (General)	TIER 2
		Sustainable Forestry	TIER 2
		Sustainable Palm Oil	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-10 Green Revenue Classification in Environmental Resources Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Environmental Resources	Advanced & Light Materials	Advanced & Light Materials (General)	TIER 1
	Key Raw Minerals & Metals	Key Raw Minerals & Metals (General)	TIER 3
		Cobalt	TIER 3
		Lithium	TIER 3
		Platinum & Platinum-Group Metals (PGM)	TIER 3
		Rare Earths	TIER 3
		Silica	TIER 3
		Uranium	TIER 3
	Recyclable Products & Materials	Recyclable Products & Materials (General)	TIER 1
		Recyclable Materials	TIER 1
		Recyclable & Reusable Products	TIER 1

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-11 Green Revenue Classification in Water Infrastructure & Technologies Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Water Infrastructure & Technologies	Advanced Irrigation Systems & Devices	Advanced Irrigation Systems & Devices (General)	TIER 1
	Desalination	Desalination (General)	TIER 1
	Flood Control	Flood Control (General)	TIER 2
	Meteorological Solutions	Meteorological Solutions (General)	TIER 1
	Natural Disaster Response	Natural Disaster Response (General)	TIER 2
	Water Infrastructure	Water Infrastructure (General)	TIER 1
	Water Treatment	Water Treatment (General)	TIER 2
		Water Treatment Chemicals	TIER 2
		Water Treatment Equipment	TIER 1
	Water Utilities	Water Utilities (General)	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-12 Green Revenue Classification in Transport Solutions Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Transport Solutions	Railways Operator	Railways Operator (General)	TIER 2
		General Railways	TIER 2
		Electrified Railways	TIER 1
	Road Vehicles	Road Vehicles (General)	TIER 3
		Bike Sharing	TIER 1
		Bus and Coach Operators	TIER 3
		Car Clubs	TIER 2
		Ride Hailing	TIER 2
	Video Conferencing	Video Conferencing (General)	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-13 Green Revenue Classification in Environmental Support & Services Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Environmental Support & Services	Environmental Consultancies	Environmental Consultancies (General)	TIER 2
	Finance & Investment	Finance & Investment (General)	TIER 2
		Carbon Credits trading	TIER 2
		Sustainable Investment Funds	TIER 2
	Smart City Design & Engineering	Smart City Design & Engineering (General)	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-14 Green Revenue Classification in Energy Management & Efficiency Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Energy Management & Efficiency	Buildings & Property (Integrated)	Buildings & Property (Integrated) (General)	TIER 1
	Controls	Controls (General)	TIER 2
	Energy Management Logistics & Support	Energy Management Logistics & Support (General)	TIER 2
	Industrial Processes	Industrial Processes (General)	TIER 1
	IT Processes	IT Processes (General)	TIER 2
		Cloud Computing	TIER 2
		Efficient IT	TIER 1
	Lighting	Lighting (General)	TIER 1
	Power Storage	Power Storage (General)	TIER 1
		Power Storage (Battery)	TIER 1
		Power Storage (Pumped Hydro)	TIER 1
	Smart & Efficient Grids	Smart & Efficient Grids (General)	TIER 1
	Sustainable Property Operator	Sustainable Property Operator (General)	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-15 Green Revenue Classification in Waste & Pollution Control Sectors

Sector Name	Sub Sector Name	Micro Sector Name	Green Tier
Waste & Pollution Control	Cleaner Power	Cleaner Power (General)	TIER 2
	Decontamination Services & Devices	Decontamination Services & Devices (General)	TIER 1
		Air Decontamination Services & Devices	TIER 1
		Land & Soil Decontamination Services & Devices	TIER 1
		Sea & Water Decontamination Services & Devices	TIER 1
	Environmental Testing & Gas Sensing	Environmental Testing & Gas Sensing (General)	TIER 2
	Particles & Emission Reduction Devices	Particles & Emission Reduction Devices (General)	TIER 1
		Industrial Pollution Reduction	TIER 1
		Transport Pollution Reduction	TIER 1
	Recycling Equipment	Recycling Equipment (General)	TIER 1
	Recycling Services	Recycling Services (General)	TIER 1
	Waste Management	Waste Management (General)	TIER 2
		Hazardous Waste Management	TIER 1
		Organic Waste Process	TIER 1
		General Waste Management	TIER 2

(Note) Classifications based on Green Revenues Classification System (GRCS)
(Source) Prepared by GPIF based on data from FTSE Russell

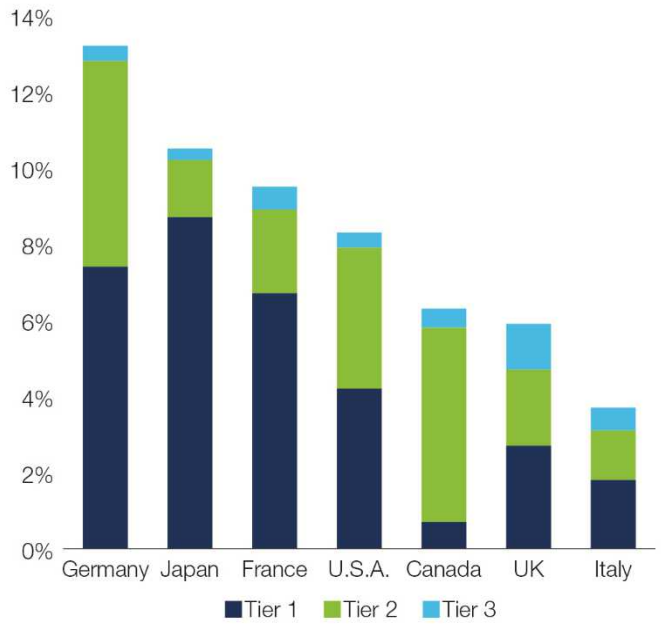
Analysis of Green Revenue Ratios Based on Green Revenue Classifications

Based on these classifications, we analyzed the percentage of green revenues to all business revenues (“green revenues ratio”) of companies covered by the MSCI ACWI. Among the MSCI ACWI constituents (approximately 3,000 companies), about 800 were evaluated as having green revenues. The green revenues ratios of each company were weighted by market capitalization to calculate the green revenue ratios for each country and tier (Figure 4-16). Among the G7 nations, Germany had the highest green revenue ratio at around 13%. The country had high proportions of Tier 1 and Tier 2 green revenues. Japan’s green revenue ratio was around 10%, with a high proportion found in Tier 1. This is because revenues from hybrid vehicles, in which Japan’s automotive manufacturers are strong, are currently classified in Tier 1. However, it should be noted that this evaluation may change, given recent moves in Europe for hybrid vehicles to no longer be considered as green revenue.

The ratio of green revenue in Japan was about 10%, and we analyzed the breakdown of green revenue in sub-sectors to identify the type of business activities included within these 10% (Figure 4-17). The sub-sector with the highest share of green revenues in Japan is Road Vehicles, accounting for about 30% of Japan's green revenues. As shown in Figure 4-17, Road Vehicles include bikes, bicycles, buses, coach manufactures, and advanced vehicle batteries, but as mentioned above, sales related to (strong) hybrid vehicles account for a large share of Japan's green revenues. The next sub-sector with the highest weight of green revenues is Industrial Processes, which accounts for about 20% of Japan's green revenues. Industrial Processes include the design, development, manufacture and installation of energy-efficient products, components and services for industrial applications. Other sub-sectors with a high share of green revenues are Building & Property (integrated) and Railway Operations.

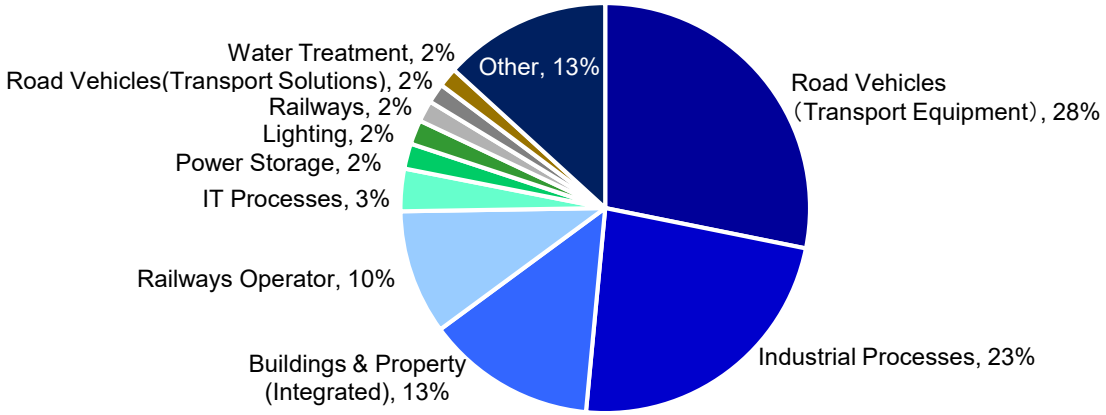
It should be noted that this analysis was conducted based on data that relies on limited information sources. Indeed, information disclosure by companies regarding their green revenues is limited, and in cases where disclosure is insufficient, revenues have been estimated using additional, non-revenue data. Also, for the sake of identifying green revenue opportunities for companies in relation with the climate crisis, it is hoped that information disclosure about companies' green revenues will increase and that understanding of the opportunities for companies of the green economy will advance.

Figure 4-16 Green Revenue Ratio by Country



(Note) Only results for constituents of MSCI ACWI in G7 countries as of March 31, 2021 are shown.
(Source) Prepared by GPIF based on data from FTSE Russell

Figure 4-17 Composition of Green Revenues in Japan (Sub-Sectors)



(Note) As of the end of fiscal 2021, MSCI ACWI constituents are listed in the 64 sub-sectors in which Japan companies' green revenues are classified, with the exception of the top 10 sectors.
(Source) Prepared by GPIF based on data from FTSE Russell

(Appendix) Special Classifications of the EU Taxonomy

About the EU Taxonomy

Regarding the discussion of "What is sustainable economic activity?". In March 2018, as part of its Action Plan for Sustainable Finance, the European Commission adopted a strategy to incorporate Environmental, Social and Governance (ESG) considerations into Europe's finance-related policy framework to promote sustainable economic growth from finance. In May 2018, the Commission published the first batch of legislation based on this plan. In it, the establishment of an EU common classification system ("Taxonomy") that defines environmentally sustainable economic activities was proposed, and the EU Taxonomy (Taxonomy) rules were established in July 2020, including ideas and original rules defining sustainable economic activities.

The EU Taxonomy addresses six key environmental objectives: climate change mitigation, climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy, pollution prevention and control, and the protection and restoration of biodiversity and ecosystems. The taxonomy considers economic activities that meet the following three conditions to be environmentally sustainable: (1) make a substantive contribution to one of six environmental objectives (meet the thresholds set by the taxonomy); (2) do no significant harm (DNSH) to the other five, where relevant; and (3) meet minimum safeguards such as the Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises and the United Nations Guiding Principles on Business and Human Rights. (4) Economic activity that falls under all of the specific indicators related to individual economic activities (technical screening criteria) is regarded as "environmentally sustainable economic activity" (Figure 4-18). The EU taxonomy requires that such activity not only have a positive impact on certain environmental objectives, but also do not negatively affect other environmental objectives.

Among the above six environmental targets, climate change mitigation and adaptation will start from January 2022. Economic activities that contribute to the reduction or prevention of GHG emissions reduction under the category of climate change mitigation include (1) activities that have already decarbonized, (2) transition activities, and (3) support activities. Climate change adaptation also includes activities that contribute to the reduction and prevention of risks regarding the adverse effects of climate change in the future. The Technical Screening Criteria, published in December 2021, defines a total of 88 types of economic activities in 9 sectors with respect to climate change mitigation. Regarding climate change adaptation, 13 sectors and a total of 95 types of economic activities have been defined (Figure 4-18). In addition, with regard to natural gas and nuclear power, whose inclusion in the Taxonomy is yet to be confirmed, a draft of Delegated Act was published in February 2022 adds certain conditions to the technical screening criteria as a sustainable economic activity.

In the following, we will go through the special classifications of the EU Taxonomy, which includes various economic activities.

Figure 4-18 Industries in the EU Taxonomy (Mitigation and Adaptation to Climate Change)

Climate change mitigation	Climate change adaptation
Forestry	Forestry
Environmental protection and restoration activities	Environmental protection and restoration activities
Manufacturing	Manufacturing
Energy	Energy
Water supply, sewerage, waste management and remediation	Water supply, sewerage, waste management and remediation activities
Transport	Transport
Construction and real estate activities	Construction and real estate
Information and communication	Information and communication
Professional, scientific and technical activities	Professional, scientific and technical activities
	Financial and insurance activities
	Education
	Human health and social work activities
	Arts, entertainment and recreation

(Source) GPIF based on the European Commission

Special classifications of EU the Taxonomy, Including Diverse Economic Activities

While the Green Revenues Classification System of FTSE Russell focused on green economic activities, economic activities classified as climate change adaptation in the EU taxonomy are characterized by the inclusion of economic activities that are not necessarily green, such as education, human health and arts & entertainments (Figure 4-19).

Specifically, education includes various educational activities such as school education and vocational education, both face-to-face and media, as well as literacy education. In addition, the activity in the art, entertainment, and recreation includes a wider variety of economic activities such as creative arts and entertainment. This category includes events, live performances and exhibitions that raise cultural or entertainment interest.

Not only in the EU, but also other various regions or countries such as Singapore and Canada are witnessing movements to formulate their own taxonomies. It is also necessary to take into account the economic situation and cultural background of each region as well as the EU taxonomy and to confirm the consistency of each from a global perspective. Therefore, in order to establish each Taxonomy, it is important to be aware of the background of each Taxonomy.

Figure 4-19 Industries and Economic Activities in the EU Taxonomy (Excerpts from Climate Change Adaptation)

Climate change adaptation	activities
Financial and insurance activities	Non-life insurance: underwriting of climate-related perils
	Reinsurance
Education	Education
Human health and social work activities	Residential care activities
Arts, entertainment and recreation	Creative, arts and entertainment activities
	Libraries, archives, museums and cultural activities
	Motion picture, video and television programme production, sound recording and music publishing activities

(Source) GPIF based on the European Commission

Introduction of Each Company

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