Forward-Looking Climate Metrics in Corporate Bond Portfolios

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Discover how implied temperature rise, carbon risk rating, and climate value at risk can inform corporate bond strategies. Uncover coverage, risk, and opportunity insights for building more climate-aware portfolios.

Introduction

As climate-related risks increasingly shape financial markets and more robust data becomes available, integrating these risks into investment strategies has, in our view, become increasingly relevant for investors with climate-related investment goals. Investor allocation to climate-themed funds and strategies have surged in recent years. A Morningstar study[2] identified 1,506 global mutual funds and exchange-traded funds (ETFs) focused on climate as of December 2023, up from fewer than 200 in 2018. While much interest from investors has centred on equity strategies, fixed income strategies account for about 13.5% of the assets under management (AUM) in these funds.

In recent years, the European Union adopted minimum standards for "Climate Transition Benchmarks"[3] and "Paris-Aligned Benchmarks," setting requirements on business activity screens, portfolio-level carbon intensity and related annual improvements, and green-to-brown revenue ratios, among others. However, these regulatory benchmarks primarily focus on backward-looking climate data. Recent investor-led guidance on net zero benchmarks,[4,5] suggests an increased focus and preference for forward-looking elements. For investors with climate-related investment goals, the challenge lies not only in understanding these factors and data sets, but also in effectively integrating them into portfolio construction. New data can help to throw light on to what was previously unknown or too complex to be able to analyse.

Company-level climate metrics are broadly classified into two main types: backward-looking data and forward-looking data. As the name suggests, "backward-looking data" refers to a company's activities in the past and covers metrics, such as a company's carbon or greenhouse gas emissions, ownership of fossil-fuel reserves, revenues derived from fossil-fuel related activities, and involvement in certain business activities. Such metrics have been available for several years, and have an established data history running at least five years or more. However, these backward-looking metrics typically omit key information related to a company's future plans, innovation or potential risks and opportunities arising from climate change. Forward-looking metrics seek to measure such plans, risks or opportunities. These include metrics like company emissions reduction targets or temperature ratings, climate scenario-based "value-at-risk" estimates and transition or physical risk ratings.

This paper aims to study the effects of incorporating forward-looking climate data in corporate bond portfolios and the effects on tracking error against a set of strategic benchmarks used by institutional investors.

The first step is identifying examples of forward-looking datasets relevant for fixed income corporate bond portfolios, examining their coverage and distribution in the applicable universe. Through a detailed correlation analysis, we reveal how these climate-related metrics interact with one another and with traditional financial indicators. Examining the tracking error trade-off for each metric in isolation provides insights on the dynamics of the portfolio balancing sustainability objectives and the potential unintended consequences this may have versus the strategic benchmark.

Finally, we offer actionable steps for incorporating these datasets into portfolio construction, leveraging advanced tools and best practices. By shedding light on some of these less familiar and fast evolving datasets, we seek to help equip investors with the knowledge necessary to navigate the landscape of climate risks and opportunities, and ultimately enhancing the ability to align sustainability goals and investment objectives.

A Summary of the Key Climate-related Data Sets Included in the Analysis

In recent years, a variety of climate-related metrics have become available from public sources as well as third-party data vendors. These sources include CDP, S&P Trucost, MSCI, ISS-ESG, and Bloomberg, among others. Climate-related datasets are nascent and have relatively short data histories compared to company fundamental data. Of these, data histories for forward-looking metrics in particular are even shorter, and methodologies are both complex and non-standardised with wide variation amongst different data providers.

In this paper, we utilise a combination of backward and forward-looking climate data supplied by MSCI ESG Research and ISS-ESG. We note that we do not differentiate between green and non-green bonds that are issued by the same company. Therefore, green bonds are treated the same — the primary driver for this approach is a lack of security-specific data for green bonds.

An overview of the various input metrics is provided in Figure 1. In the following sub-sections, we describe the various metrics we use in some more detail.

Figure 1 **Overview of Climate Metrics Used in this Paper**

Metric Name (Abbr.)	Definition	Units	Data Source	History Available	Range	Interpretation*
Descriptive (or Backwards-Looking) Climate Metrics						
Carbon Intensity (CI)	Scope 1 and Scope 2 emissions per $M revenue	Tonnes of CO2-eq per $m	MSCI	2012	Positive values	Lower is better
Potential Emissions (PE)	Potential emissions related to fossil-fuel reserves ownership	Million tonnes of CO2-eq	MSCI	2017	Positive values	Lower is better
Brown Revenues (BR)	% of revenues derived from fossil-fuel related activities	%	MSCI	2017	0 to 100%	Lower is better
Forward-Looking Climate Metrics						
Implied Temperature Rise (ITR)	The global temperature rise (in the year 2100) if the whole economy had the same carbon budget over-/undershoot level as the company analyzed	Degrees Celsius	MSCI	2022	1.3 to 10	Lower is better
Carbon Risk Rating (CRR)	Rating which measures a company's preparedness for a low-carbon economy	N/A	ISS-ESG	2016	0 to 100	Higher is better
Policy Climate Value at Risk (Pol-CVaR)	A company's aggregated downside policy risk exposure	% of market value	MSCI	2022	-100 to 0%	Higher (less negative) is better
Technology Climate Value at Risk (Tec-CVaR)	A company's upside technology opportunity exposure	% of market value	MSCI	2022	0–100%	Higher (more positive) is better
Physical Value at Risk (Phy-CVaR)	A company's expected downside or upside potential from physical climate changes	% of market value	MSCI	2022	-100 to 100%	Higher (less negative) is better

Source: State Street Global Advisors, MSCI ESG Research, ISS-ESG, as of August 2024.
* The interpretation is provided for readers viewing these metrics from a risk/opportunity lens. For example, assuming carbon intensity as a proxy for climate risk, a lower value is better (considered to be less risky).

As shown in Figure 1, we utilise three types forward-looking metrics in this paper: implied temperature rise (ITR), carbon risk rating (CRR), and climate value at risk (CVaR). The CVaR is in turn divided into three components: policy, technology and physical CVaR. These are described below.

Implied Temperature Rise (ITR)

Temperature alignment scores assess the myriad company emissions reduction targets and assign companies a "temperature score", making them more easily comparable and interpretable. Such temperature scores are also known by various names, for example, Implied Temperature Rise (ITR), Temperature Alignment, Paris Alignment, etc. Here we provide a brief overview of MSCI's methodology for ITR.

There are several steps involved but the first is that a company is assigned a carbon budget based on the projections of the Network for Greening the Financial System (NGFS) REMIND Net Zero 2050 model scenario.[6] Next, companies' future emissions are projected based on its stated targets and adjusted based on a credibility assessment. Third, the company's projected emissions are compared with its carbon budget, and an overshoot or undershoot factor is calculated. As a final step, this over/undershoot is converted into a temperature figure based on an estimated relationship between carbon emissions and temperature outcomes.

We note that such methodologies are inherently complex and involve several assumptions and modelling choices made by data vendors. We also note that calculation of ITR scores at the portfolio level is recommended to be done using an "aggregate budget method". We omit technical detail here, but simply note that this measure differs from the weighted average method that is typically used to calculate portfolio-level statistics. In the following sections, we specify whether ITR calculations are presented using a portfolio weighted average, or aggregate budget method, but note that in general the takeaways do not differ materially based on either method.

Carbon Risk Rating (CRR)

Carbon Risk Rating (CRR) is a climate transition risk assessment developed by ISS-ESG.[7] The CRR is comprised of two main parts:

1. **Carbon Risk Classification** assesses a company's exposure to carbon-related transition risks by estimating its emission intensity in the company's value chain, based on its industry and business activities.

2. **Carbon Performance Score** evaluates the current carbon-related performance of a company as well as a company's risk management and measures to reduce its carbon intensity in the future.

ISS-ESG combines the two components and rescales such that each company can obtain a score between 0–100, where 0 is seen as high risk (worst score), and 100 is seen as low risk (best score). Effectively, the CRR is a metric that assigns a risk rating to a company based on its sector and business activities, as well as its efforts to manage potential transition risks.

Climate Value at Risk (CVaR)

MSCI's Climate Value at Risk (CVaR) seeks to quantify the potential impacts of climate change into a dollar value impact on a company's valuation. This is typically expressed as a percentage of the company's market value over a 15-year time horizon under different climate scenarios. MSCI calculates the CVaR for its covered universe under a variety of climate scenarios (orderly transition, disorderly transition, hothouse world and temperature outcomes ranging from 1.5°C to 3°C). The CVaR metric is also further broken down into three components: Policy Risks (Pol-CVaR), Technology Opportunities (Tec-CVaR), and Physical Risks (Phy-CVaR). These loosely correlate to transition risks, transition opportunities and physical risks.

- **Policy Risks CVaR (Pol-CVaR)** models the potential negative impacts to company financials under future policies (proxied using carbon prices) projected under various climate scenarios.

- **Technology Opportunities CVaR (Tec-CVaR)** models the potential positive impacts of low-carbon patents on company financials under various climate scenarios.

- **Physical Risks CVaR (Phy-CVaR)** models the potential positive or negative impacts of various physical climate events (extreme cold, extreme heat, extreme precipitation, heavy snowfall, extreme wind, coastal flooding, fluvial flooding, tropical cyclones, river low flow and wildfires) under various climate scenarios.

In this paper, we utilise CVaR estimates under the NGFS REMIND Net Zero 2050 scenario, and study each sub-component separately.

Index Data

Benchmark indices are selected by market participants for a variety of reasons, but some of the key features investors typically seek include the breath of the fixed income market captured, standardisation of an index's security inclusions/exclusion criteria, pricing transparency of the underlying holdings, supporting analytics available on portfolio management systems, and flexibility to disaggregate particular segments of the covered universe.

We study the climate data characteristics of the following six indices in this article, although portfolio analysis is conducted only for the Global IG USD index.[8]

- Bloomberg Global Investment Grade Corporate Aggregate Index (Global IG)
- Bloomberg Global Investment Grade Corporate USD Aggregate Index (Global IG USD)
- Bloomberg United States Investment Grade Corporate Aggregate Index (US IG)
- Bloomberg Pan Euro Investment Grade Corporate Aggregate Index (EUR IG)
- Bloomberg United States High Yield Corporate Aggregate Index (US HY)
- Bloomberg Pan Euro High Yield Corporate Aggregate Index (EUR HY)

Figure 2
Descriptive Statistics of Selected Corporate Bond Indices

Index	Global IG	Global IG USD	US IG	EUR IG	US HY	EUR HY
No. Securities	16,393	10,165	8,000	3,704	1,949	664
No. Issuers	2,484	1,803	969	791	750	285
Total Market Value ($B)	12,040	8,109	6,621	2,856	1,284	360
Option-adjusted Duration (OAD)	5.97	6.55	6.92	4.51	3.19	2.85
Option-adjusted Spread (OAS)	94.56	87.87	84.64	107.87	308.21	321.81
Yield to Worst	5.10	5.56	5.52	3.88	8.00	6.31
Index Rating Number	8.20	8.18	8.18	8.34	15.06	13.98

Source: State Street Global Advisors, Bloomberg, as of 31 May 2024.

Data Distribution and Relationships

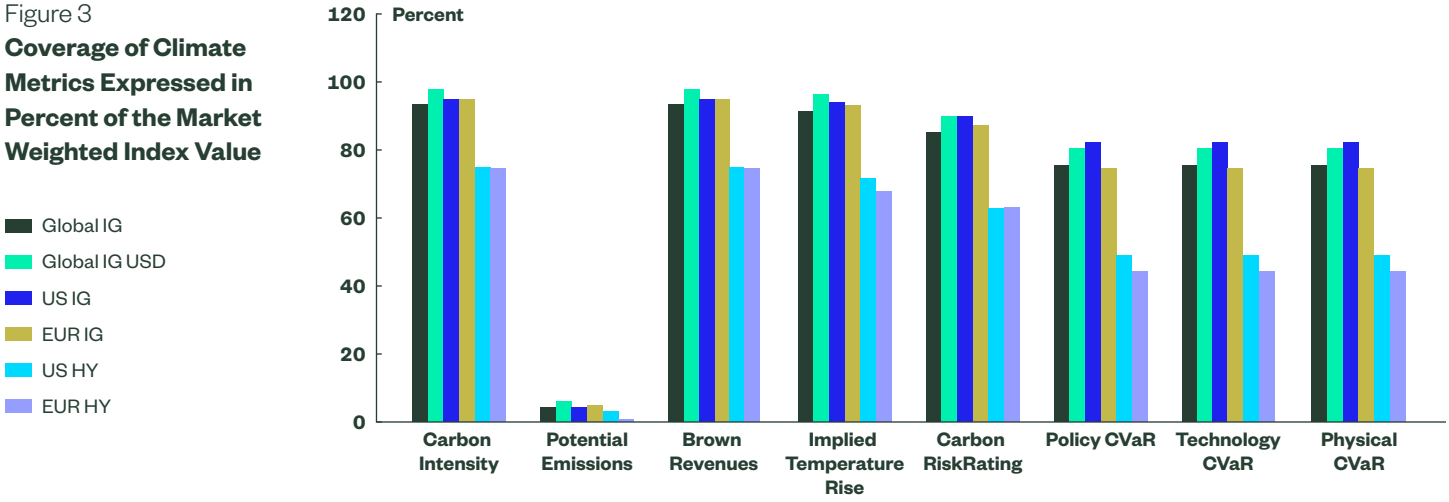
Using an issuer-level identifier system provided by Bloomberg we map the climate data to ISINs based on their issuer. We make the following observations:

- Coverage of the potential emissions metric appears to be poor, however in reality is a quirk of the data. Given most companies do not own fossil fuel reserves, these are reported as nulls even if the company is assessed for other metrics. In this case, it is more representative to consider the coverage of fossil fuels to be the same as that of carbon intensity and brown revenues.

- Within investment grade indices, coverage is strong for backward-looking metrics (over 90%), while is a bit varied for forward-looking data. Among these CRR and ITR have good coverage (over 85%), while that for CVaR metrics is slightly weaker across the board.

- Within high yield universes, we notice a similar trend vis-à-vis backward vs forward-looking metrics, however we observe that the coverage is weaker across all data points relative to investment grade.

Figure 3
Coverage of Climate Metrics Expressed in Percent of the Market Weighted Index Value



Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Sustainability datasets tend to be based on public financial disclosures by companies and therefore, they overwhelmingly focus on publicly listed companies. The credit space is composed of both public as well as private companies, the latter of which are not subject to the same public disclosure reporting requirements. As a result, coverage of private companies (which form a meaningful proportion of the high yield universe) tends to be poor in comparison.

When utilising climate data metrics for practical portfolio construction use cases, missing data can be treated in two main ways: exclude securities that are not covered and missing value imputation or gap-filling.

The main drawback with the first option is that it can lead to high tracking error impact due to blunt exclusion, and consequently a gap-filling approach is typically preferred. For this research, we employ an approach based on the economic sector a company operates in using primarily the NACE classification which is recommended under the EU's Climate Benchmark regulation, and can be used across both equity and fixed income asset classes. Therefore, we fill in missing values for our climate metrics using the medians calculated by (in order of availability) (i) NACE sectors; (ii) Bloomberg Class 3 sectors. For the sections following, all statistics and inferences are presented using climate data gap-filled by the process described here.

In Figure 4, we look at the overall climate data scores for each of the selected index universes. In general, we observe that the US IG and US HY have higher climate-related risk exposures across the majority of metrics considered here, relative to EUR IG and EUR HY. Additionally, relative to their investment grade counterparts, the two high yield universes (US HY and EUR HY) tend to have higher climate-related risk exposure along ITR, CRR, and Policy CVaR metrics, while having lower or comparable exposure along other metrics, including potential emissions, carbon intensity, and Tech CVaR.

Figure 4
Climate Data Scores by Selected Index Universes

	Global IG	Global IG USD	US IG	EUR IG	US HY	EUR HY
Carbon Intensity	181.07	241.25	247.96	95.75	223.30	104.24
Potential Emissions	83.35	89.13	92.75	94.50	11.69	2.78
Brown Revenues	8.80	9.50	10.70	5.60	12.50	2.30
ITR (weighted average)	2.41	2.51	2.47	2.32	2.93	2.31
ITR (agg. budget)	2.35	2.48	2.58	2.09	3.30	2.21
Carbon Risk Rating	56.69	55.74	56.18	59.73	45.32	54.29
Policy CVaR	-11.97	-11.87	-11.73	-12.75	-15.29	-13.83
Technology CVaR	1.76	1.22	1.15	3.45	0.89	3.80
Physical CVaR	-1.31	-1.30	-1.14	-1.38	-1.54	-1.40

Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

In order to better understand the distribution of climate data across sectors, we now present sector weighted averages for the climate metrics within the broad Global IG universe and ranked them. We note the following observations:

- There is significant variation across different sectors, and climate-related risks tend to be concentrated in some sectors over others.
- Most notably Energy, Basic Industry, Electric Utility, and Natural Gas Utility generally have highest risk exposure to the climate-related metrics considered here, but also tend to have higher opportunities as measured by Technology CVaR, which supports earlier academic research (Cohen et al 2020).
- Other Utility companies also score well on Technology CVaR, but may still be exposed to higher Policy CVaR and Physical CVaR on an aggregate basis.

Figure 5 **Climate Data Scores by Selected Index Universes**

Bloomberg Class 3 Sector	Index Weight (%)	Carbon Intensity	Potential Emissions	Brown Revenues (%)	Implied Temp.	Carbon Risk Rating	Pol-CVaR	Tec-CVaR	Phy-CVaR
Energy	5.80	401.20	1267.40	92.70	3.15	28.24	-59.85	7.86	-3.55
Basic Industry	2.90	442.90	279.10	3.20	4.69	46.25	-46.78	5.52	-2.92
Electric Utility	7.10	1467.30	2.30	32.20	2.64	41.54	-36.16	8.60	-1.51
Natural Gas Utility	1.30	497.40	8.40	63.00	1.98	43.15	-34.54	6.93	-1.87
Other Industrials	0.60	126.70	231.70	3.30	2.50	49.07	-10.04	2.29	-3.60
Transportation	2.90	259.10	0.00	2.00	2.74	53.81	-19.56	0.84	-2.90
Finance Companies	1.00	7.20	0.00	0.00	2.99	45.18	-0.93	0.00	-6.15
Other Financials	1.40	59.00	0.00	0.00	3.09	45.79	-1.58	0.11	-2.18
Capital Good	4.90	182.60	0.30	0.70	3.22	47.71	-13.01	3.44	-0.77
Other Utility	0.60	433.40	0.00	2.90	2.18	50.64	-28.61	22.50	-2.50
Consumer Cyclical	7.90	27.80	0.10	1.40	2.60	49.2	-16.55	0.82	-1.81
REITs	2.60	66.70	0.00	0.00	2.40	54.52	-0.92	0.06	-1.03
Consumer Non-Cyclical	13.40	31.60	0.00	0.00	1.93	64.39	-5.48	0.13	-1.24
Communications	7.30	28.00	1.80	0.00	1.66	65.60	-2.64	0.04	-1.07
Insurance	5.90	12.20	1.60	0.20	1.69	59.08	-1.75	0.00	-0.79
Banking	26.50	3.90	0.00	0.00	2.42	65.28	-0.67	0.00	-0.43
Technology	6.40	28.40	0.00	0.00	1.92	66.65	-2.37	0.38	-0.98
Brokerage, Asset Managers & Exchanges	1.60	2.80	0.00	0.80	2.18	56.58	-0.75	0.12	-0.36

Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024. The colour in each cell shows how well that sector performs for that specific metric compared to the other sectors. Darkest blue indicates the best performance for that metric, while dark red indicates the worst. This comparison is done separately for each metric column.

Data Relationships

To study the correlations between the various metrics we utilise Normalized Mutual Information Ratio (NMI) and decile weighted averages. The NMI is a clustering-based method that is commonly used to understand data relationships in machine learning applications, and typically performs well at modelling non-linear relationships. NMI can be interpreted as the decrease in uncertainty in X that results from knowing the value of Y.

In addition to the NMI, we also report decile weighted averages by dividing the index universe into deciles based on selected climate metrics. We report these statistics as an additional robustness check — this method accounts for index weights of various issuers, while the NMI weights all issuers equally.

We make the following observations:

- As may be expected, the three backward-looking metrics appear to have a relationship with each other — companies with high carbon intensity also tend to have high brown revenues or potential emissions.
- Carbon intensity also appears to be related to the forward-looking metrics: companies with high carbon intensity also have poor CRR and Policy CVaR. Interestingly, companies with high carbon intensity also tend to have higher Tech CVaR — this further supports the finding from the sector analysis in the previous section.
- CRR and Policy CVaR also appear to have a relationship with the backward-looking metrics. Companies that have higher exposure to these two dimensions also have higher exposure to carbon intensity, potential emissions and brown revenues. The relationship of these metrics with Tech CVaR is also similar to that of carbon intensity — higher risk companies also have higher Tech CVaR.
- Looking at ITR, we see that the relationship across different metrics is weaker in comparison, although directionally similar.
- Lastly, Physical CVaR may have a weak relationship with Policy CVaR and Tech CVaR, but not with the other metrics in consideration.

In summary, it appears that CRR and Policy CVaR capture a lot of information contained within backward-looking data points while ITR, Tech CVaR and Physical CVaR appear to contain additional complementary information. In addition, these broad relationships appear to hold across the six universes we have studied, and below we provide an example based on the Bloomberg Global IG Corporate Bond Index.

Figure 6
Normalized Mutual Information Ratio (NMI) in the Bloomberg Global IG Corporate Bond Index (Global IG)

	CI	BR	PE	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
CI	1.00	0.44	0.01	0.26	0.23	0.37	0.02	0.02
BR	0.44	1.00	0.34	0.09	0.22	0.28	0.13	0.04
PE	0.01	0.34	1.00	0.19	0.38	0.39	0.13	0.06
ITR	0.26	0.09	0.19	1.00	0.07	0.09	0.10	0.06
CRR	0.23	0.22	0.38	0.07	1.00	0.18	0.10	0.10
Pol-CVaR	0.37	0.28	0.39	0.09	0.18	1.00	0.25	0.13
Tec-CVaR	0.02	0.13	0.13	0.10	0.10	0.25	1.00	0.07
Phy-CVaR	0.02	0.04	0.06	0.06	0.10	0.13	0.07	1.00

Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024. Colour indicates the magnitude of the information two random variables share, with warmer colours (reds) showing lower alignment, and cooler colours (blues) showing stronger alignment.

We now present weighted averages by dividing the Global IG index universe into deciles based on ranking index constituents by a number of climate metrics. Note each decile is very close to 10% of total weight but not exactly. We do not present deciles based on Potential Emissions, Brown Revenues, and Tech CVaR due to the low number of non-zero values available, meaning that decile comparisons are not sensible.

Figure 7(a)-(e): Weighted averages within deciles created by ranking securities based on climate metrics within the Global IG universe. The deciles are created for each metric by ranking securities based on perceived risk exposure (low risk = decile 1, high risk = decile 10).

Figure 7a
Deciles based on Carbon Intensity

Decile	Index Weight (%)	No. Securities	CI	PE	BR (%)	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
1	10.0	1702	0.8	0.0	0.1	2.24	65.24	-1.60	0.03	-0.81
2	10.0	1421	2.2	0.0	0.0	1.92	63.30	-0.88	0.11	-0.51
3	10.0	1297	3.7	0.0	0.0	2.50	64.88	-1.79	0.04	-0.82
4	10.0	1183	5.8	0.7	0.0	2.24	62.88	-1.32	0.38	-0.49
5	10.0	1337	10.6	0.0	0.6	2.14	64.30	-3.09	0.18	-0.80
6	10.0	1588	20.6	0.8	0.5	2.49	54.35	-9.32	0.66	-1.95
7	10.0	1669	31.3	0.0	1.2	2.06	57.98	-7.50	0.93	-1.16
8	10.0	2044	63.0	57.0	4.6	2.29	52.14	-8.98	1.42	-1.75
9	10.0	1968	242.6	679.4	41.1	2.69	40.54	-41.48	8.02	-2.88
10	10.0	2184	1429.9	95.6	40.1	3.55	41.33	-43.74	5.86	-1.97

Figure 7b
Deciles based on Implied Temperature Rise

Decile	Index Weight (%)	No. Securities	CI	PE	BR (%)	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
1	10.0	1505	58.4	0.0	2.5	1.30	65.41	-7.29	3.30	-1.15
2	10.0	1514	51.8	0.0	2.6	1.45	64.92	-5.35	0.58	-0.88
3	10.0	1567	47.7	0.3	4.4	1.58	61.51	-5.96	0.86	-1.01
4	10.0	1851	63.3	1.0	3.7	1.75	59.13	-7.56	1.00	-1.16
5	10.0	1672	134.5	201.2	11.9	1.94	51.95	-15.14	2.80	-1.95
6	10.0	1679	76.0	107.8	6.1	2.13	55.19	-10.07	1.73	-0.99
7	10.0	1615	158.7	88.1	11.0	2.34	52.55	-13.69	1.37	-1.24
8	10.0	1477	178.2	81.0	12.7	2.63	55.34	-13.79	2.27	-1.40
9	10.0	1841	319.8	48.2	11.9	3.21	53.16	-13.25	0.94	-1.15
10	10.0	1672	722.2	305.7	21.4	5.81	47.75	-27.59	2.80	-2.22

Figure 7c
Deciles based on Carbon Risk Rating

Decile	Index Weight (%)	No. Securities	CI	PE	BR (%)	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
1	10.0	1301	22.6	0.0	0.3	1.70	79.53	-2.82	0.82	-1.13
2	10.0	1305	33.5	0.0	0.3	2.43	71.50	-2.63	0.15	-0.88
3	10.0	1351	10.3	0.0	0.0	1.97	67.66	-1.53	0.02	-0.60
4	10.0	1057	20.4	0.0	0.4	2.15	64.66	-1.84	0.12	-0.64
5	10.0	1491	89.1	0.0	2.1	2.34	61.99	-5.38	1.09	-0.86
6	10.0	1777	76.4	5.6	2.4	2.25	56.24	-5.29	1.00	-1.07
7	10.0	2036	89.8	5.7	1.3	2.60	51.11	-8.66	1.96	-0.96
8	10.0	2090	131.4	1.4	4.6	2.64	45.90	-14.30	2.59	-1.58
9	10.0	2069	727.7	4.2	25.4	3.00	40.33	-27.39	3.91	-2.72
10	10.0	1916	609.8	816.6	51.4	3.05	27.97	-49.87	6.00	-2.69

Source for all tables: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Figure 7d
Deciles based on Policy CVaR

Decile	Index Weight (%)	No. Securities	CI	PE	BR (%)	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
1	10.0	1278	7.0	0.0	0.0	2.22	66.06	-0.33	0.01	-0.39
2	10.0	1080	12.4	0.0	0.0	2.31	64.56	-0.58	0.01	-0.51
3	10.0	1427	5.9	0.0	0.0	2.15	63.14	-0.81	0.03	-0.44
4	10.0	1824	12.0	0.0	0.0	2.30	59.48	-0.91	0.01	-0.64
5	10.0	1672	24.2	0.0	0.0	1.91	62.47	-1.34	0.44	-1.58
6	10.0	1575	34.5	0.0	0.5	2.08	63.09	-2.61	0.44	-0.83
7	10.0	1634	42.0	2.1	2.8	2.20	60.07	-5.22	0.60	-1.31
8	10.0	1867	145.1	9.7	8.1	2.90	50.03	-11.41	1.83	-1.57
9	10.0	2302	872.2	18.5	29.6	2.67	43.21	-28.61	4.48	-2.53
10	10.0	1734	655.7	803.7	47.3	3.39	34.80	-67.91	9.80	-3.33

Figure 7e
Deciles based on Physical CVaR

Decile	Index Weight (%)	No. Securities	CI	PE	BR (%)	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
1	10.0	1511	123.7	38.7	4.5	2.21	61.56	-4.87	0.88	0.05
2	10.0	1385	70.7	0.0	1.4	2.62	61.54	-2.68	0.62	-0.20
3	10.0	1594	18.0	0.0	0.1	2.07	61.44	-1.22	0.07	-0.30
4	10.0	1422	36.5	0.4	1.6	2.27	61.02	-2.91	0.17	-0.34
5	10.0	1662	120.4	2.6	3.4	2.69	55.96	-5.12	0.87	-0.48
6	10.0	1814	87.3	56.5	5.0	2.18	59.96	-6.71	0.85	-0.65
7	10.0	1515	132.1	32.5	5.6	2.48	54.01	-13.76	1.73	-0.88
8	10.0	2111	802.1	55.8	24.7	2.62	49.75	-24.82	3.53	-1.23
9	10.0	1694	177.0	96.2	14.2	2.45	54.39	-21.54	1.06	-2.32
10	10.0	1685	242.8	551.0	27.8	2.55	47.29	-36.10	7.85	-6.79

Source for all tables: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Portfolio Analysis

For this part of the paper, we restrict our analysis to the Global IG USD universe for three main reasons:

1. maintain a global universe but remove the effects of currency;
2. the findings are generalisable to other regional-focused universes;
3. coverage is marginally better relative to other universes (e.g Global High Yield) studied and hence minimises any impact from missing value treatments.

In order to construct portfolios that seek to improve the climate profile relative to the index, we chose to select simple portfolio weighted averages as the target metric (except for ITR, which is described further below). Securities were ranked based on the target metric (e.g., carbon intensity), and the companies scoring the worst were screened out one by one (weight is reallocated to the remaining names proportionally) until the target objective was achieved (e.g., 20% reduction in weighted average carbon intensity). For ITR, we followed a similar approach; however, the target objective was calculated using the aggregated budget method (rather than weighted average). When multiple securities were tied, we screened out the one with the lowest index weight first and proceeded as before. We constructed the following hypothetical portfolios[9] and note that there is a certain level of subjectivity to choosing the level of improvements for various targets. However, we believe the range below covers commonly used targets by investors seeking to incorporate climate-thematic investment objectives into their portfolios.

Figure 8
Details of Portfolio Target Metrics and Objectives Relative to the Standard Market Capital Weighted Index

Target Metric	Calc. Method	Target Type	Target Objective				
Carbon Intensity	Weighted Average	Relative reduction	-20%	-40%	-60%	-80%	
Potential Emissions	Weighted Average	Relative reduction	-20%	-40%	-60%	-80%	-100%
Brown Revenues	Weighted Average	Relative reduction	-20%	-40%	-60%	-80%	-100%
Implied Temp.	Aggregated Budget	Absolute Level target	2.25	2.00	1.75	1.50	
Carbon Risk Rating	Weighted Average	Relative improvement	10%	20%	30%		
Policy CVaR	Weighted Average	Relative reduction	-20%	-40%	-60%	-80%	
Technology CVaR	Weighted Average	Relative improvement	10%	20%	30%	40%	
Physical CVaR	Weighted Average	Relative reduction	-20%	-40%	-60%	-80%	

Source: State Street Global Advisors, MSCI ESG Research, ISS-ESG. Note: Target objectives reflect feasible reduction levels for each metric based on their underlying methodology. For example, while complete elimination (-100%) is feasible for potential emissions and brown revenues, other metrics like carbon intensity have structural limitations that make complete elimination impractical at the portfolio level while maintaining broad market exposure. The above targets are estimates based on certain assumptions and analysis made by SSGA. There is no guarantee that the targets will transpire into actual results.

For simplicity, the tables in the following section only report the weighted average ITR. However, we state that the interpretation and directionality are quite similar regardless of the approach selected.

We employ this simple approach since we are constructing portfolios based on a single target metric. Where there is a large number of sustainability objectives to consider in the portfolio's construction, an optimizer may be used to define the initial eligible opportunity set from which the portfolio will then seek to replicate.

For the construction of portfolios holding physical bonds, due to the large number of securities in broad credit market indices, liquidity characteristics and transaction costs may render full replication of the index either impossible or not economically attractive. Hence, almost all credit strategies that cannot be fully replicated will usually be managed based on an approach called stratified sampling.[10] Consequently, the impact of climate metric incorporation in practical portfolio management may have a slight difference relative to the research here but the key finding will likely still apply regardless.

We examined the impacts of these sets of portfolios targeting improvement in a single climate metric along three dimensions:

1. Their impact on other climate metrics (e.g., portfolios that reduce carbon intensity are also studied for improvements in policy CVaR, potential emissions, and all other metrics).

2. The effects on fundamental portfolio characteristics like tracking error, duration, yield, etc.

3. The effect on weights in selected sectors.

Impact on Other Climate Metrics

Figure 9(a)-(h): Improvements in climate metrics relative to the benchmark. All statistics are reported using simple weighted averages.

Figure 9a
Portfolios Targeting Improvement in Carbon Intensity

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	-20	-9	-6	-3	1	-4	2	2
Portfolio 2 (%)	-40	-8	-12	-4	2	-8	-3	2
Portfolio 3 (%)	-60	-6	-20	-5	2	-14	-8	2
Portfolio 4 (%)	-80	-13	-45	-9	4	-33	-17	-5

Figure 9b
Portfolios Targeting Improvement in Fossil Fuel Reserves

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	7	-31	-4	-1	1	-3	6	1
Portfolio 2 (%)	7	-42	-6	-2	1	-4	6	1
Portfolio 3 (%)	7	-61	-10	-2	1	-7	-6	0
Portfolio 4 (%)	7	-81	-16	-2	2	-11	-18	-2
Portfolio 5 (%)	4	-100	-27	-4	3	-19	-19	-4

Figure 9c
Portfolios Targeting Improvement in Brown Revenues

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	5	-13	-21	-2	1	-5	7	0
Portfolio 2 (%)	4	-60	-41	-2	3	-14	-3	-3
Portfolio 3 (%)	-7	-90	-60	-5	4	-24	-20	-7
Portfolio 4 (%)	-38	-92	-80	-7	5	-32	-26	-7
Portfolio 5 (%)	-70	-99	-100	-8	7	-52	-53	-15

Figure 9d
Portfolios Targeting Improvement in Implied Temperature Rise

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	-29	-26	-17	-14	2	-16	-5	-9
Portfolio 2 (%)	-45	-52	-35	-20	4	-29	-12	-14
Portfolio 3 (%)	-68	-67	-49	-28	5	-36	-21	-15
Portfolio 4 (%)	-72	-95	-57	-32	9	-46	-41	-18

Figure 9e
Portfolios Targeting Improvement in Carbon Risk Rating

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	-64	-99	-78	-8	10	-54	-50	-13
Portfolio 2 (%)	-80	-99	-90	-14	20	-74	-75	-33
Portfolio 3 (%)	-88	-100	-98	-19	30	-80	-90	-35

Source for all tables: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Figure 9f
Portfolios Targeting Improvement in Policy Risk CVaR

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	-6	-52	-15	-4	2	-20	-22	-5
Portfolio 2 (%)	-21	-87	-35	-6	4	-40	-35	-8
Portfolio 3 (%)	-64	-95	-56	-10	6	-61	-62	-13
Portfolio 4 (%)	-85	-98	-85	-11	10	-80	-82	-29

Figure 9g
Portfolios Targeting Improvement in Tech Opps CVaR

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
Index Level	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
Portfolio 1 (%)	9	-1	7	-2	0	5	16	7
Portfolio 2 (%)	15	6	11	0	-1	9	25	11
Portfolio 3 (%)	22	7	16	1	-2	14	35	15
Portfolio 4 (%)	31	15	25	-1	-4	22	44	19

Figure 9h
Portfolios Targeting Improvement in Physical Risks CVaR

Metrics	CI	FF	BR	ITR	CRR	Pol-CVaR	Tec-CVaR	Phy-CVaR
PORT_PCT	241.3	89.1	9.54	2.51	55.74	-11.87	1.22	-1.30
WT_PHYVAR_20 (%)	8	-11	-3	-2	1	-4	2	-20
WT_PHYVAR_40 (%)	6	-51	-22	-3	2	-16	-20	-40
WT_PHYVAR_60 (%)	-5	-71	-33	-4	3	-32	-31	-60
WT_PHYVAR_80 (%)	-57	-87	-74	-7	7	-68	-65	-80

Source for all tables: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Figure 10 looks at the ex-ante performance Tracking Error Volatility (TEV) trade-off analysis for each metric in isolation relative to the Bloomberg Global Investment Grade Corporate USD Aggregate Index (Global IG USD).

Figure 10
Ex-ante 1 year Tracking Error of Model Portfolios Relative to the Global IG USD index

Tracking Error (in bps)					
Target (%)	-20	-40	-60	-80	
CI	8.1	12.3	15.6	19.9	
Target (%)	-20	-40	-60	-80	-100
FF	5.2	5.0	6.2	7.1	9.0
Target (%)	-20	-40	-60	-80	-100
BR	6.3	8.7	11.8	15.5	31.3
Target	2.25	2.00	1.75	1.50	
ITR	9.0	7.4	17.7	37.4	
Target (%)	10	20	30		
CRR	17.6	24.0	38.4		
Target (%)	-20	-40	-60	-80	
Pol-CVaR	9.7	12.2	19.8	25.4	
Target (%)	10	20	30	40	
Tec-CVaR	9.4	16.4	13.1	16.1	
Target (%)	-20	-40	-60	-80	
Phy-CVaR	4.0	6.4	10.6	49.9	

Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024. Colour indicates the magnitude of the tracking error, with warmer colours (reds) showing larger errors and cooler colours (blues) showing smaller errors.

Figure 11 **Fundamental Portfolio Characteristics of Climate Improvement Portfolios**

Option-Adjusted Duration
Reference Level = 6.55

Target (%)	-20	-40	-60	-80	
CI	-1.0	-1.6	-2.1	-2.7	
Target (%)	-20	-40	-60	-80	-100
FF	-0.5	-0.4	-0.7	-0.8	-1.1
Target(%)	-20	-40	-60	-80	-100
BR	-0.6	-1.0	-1.4	-2.1	-4.5
Target	2.25	2.00	1.75	1.5	
ITR	-1.1	-0.5	2.0	5.4	
Target (%)	10	20	30	40	
CRR	-2.2	-2.3	3.1	6.6	
Target (%)	20	40	60	80	
TEC	-1.0				
Target (%)	-20	-40	-60	-80	
POL	-1.3	-1.7	-2.7	-3.3	
Target (%)	-20	-40	-60	-80	
PHY	-0.1	-0.5	-1.1	-7.1	

Option-Adjusted Spread
Reference Level = 87.87

Target (%)	-20	-40	-60	-80	
CI	-0.6	-0.6	-0.9	-2.0	
Target (%)	-20	-40	-60	-80	-100
FF	-0.4	-0.3	-0.2	-0.1	-0.4
Target(%)	-20	-40	-60	-80	-100
BR	-0.7	-0.7	-1.0	-1.3	-1.5
Target	2.25	2.00	1.75	1.50	
ITR	-0.6	-1.3	-0.4	-1.0	
Target (%)	10	20	30	40	
CRR	-2.4	-7.7	-10.6	-14.2	
Target (%)	20	40	60	80	
TEC	-0.6				
Target (%)	-20	-40	-60	-80	
POL	-0.5	-0.8	-1.4	-2.8	
Target (%)	-20	-40	-60	-80	
PHY	-0.7	-0.7	-1.0	-1.9	

Index Rating Numeric Representation
AAA = 2, BAA3 = 11; Reference Level = 8.18

Target (%)	-20	-40	-60	-80	
CI	0.0	0.2	0.0	-1.0	
Target (%)	-20	-40	-60	-80	-100
FF	0.0	0.0	0.1	0.3	0.1
Target (%)	-20	-40	-60	-80	-100
BR	-0.5	-0.5	-0.6	-0.7	-0.8
Target	2.25	2.00	1.75	1.50	
ITR	-0.1	-1.1	-0.4	-1.2	
Target (%)	10	20	30	40	
CRR	-1.2	-4.8	-5.8	-9.3	
Target (%)	20	40	60	80	
TEC	0.0				
Target (%)	-20	-40	-60	-80	
POL	0.0	-0.4	-0.6	-2.0	
Target (%)	-20	-40	-60	-80	
PHY	-0.3	-0.4	-0.9	-3.4	

Yield to Worst
Reference Level = 5.56

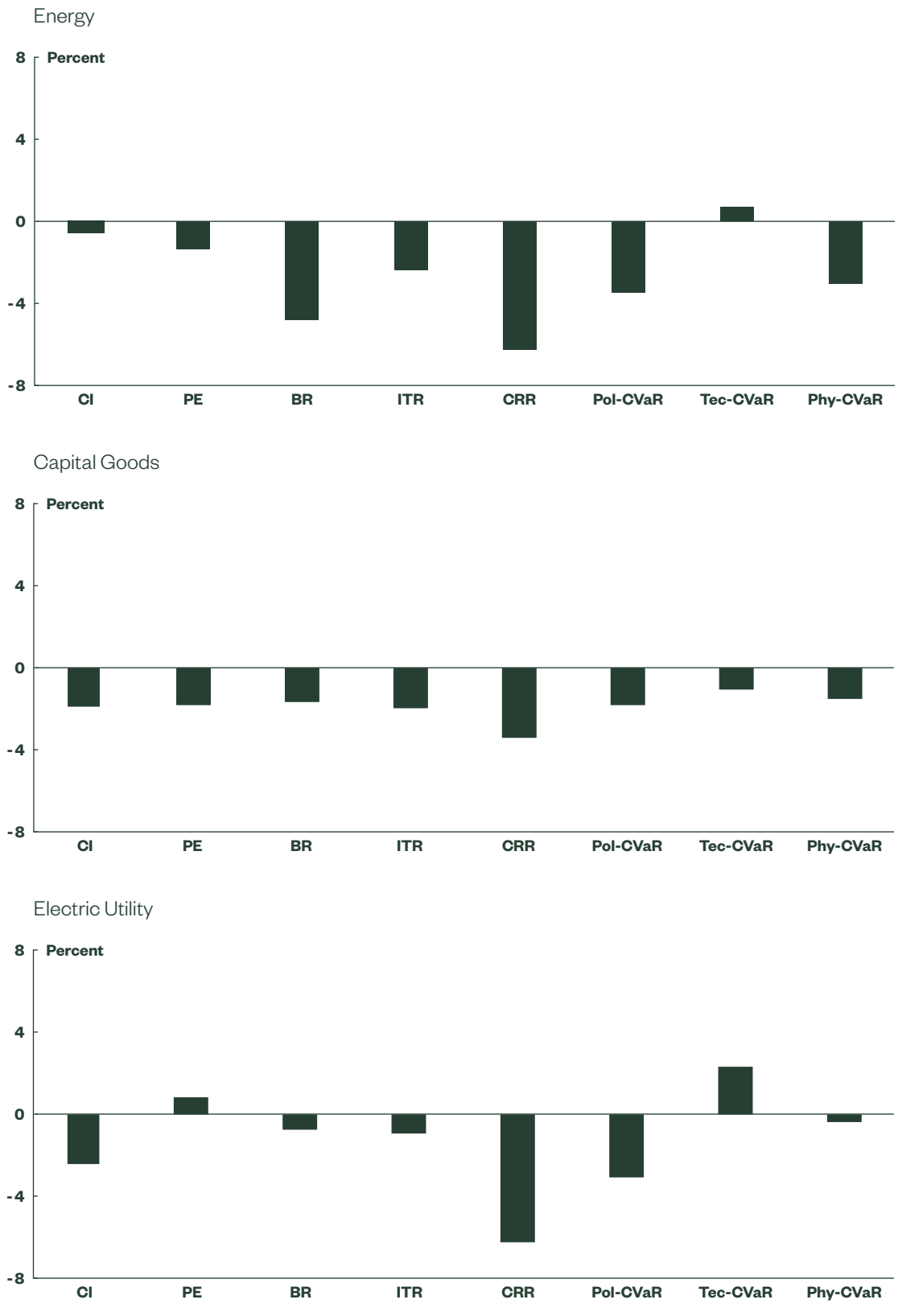
Target (%)	-20	-40	-60	-80	
CI	-0.1	-0.1	-0.1	-0.3	
Target (%)	-20	-40	-60	-80	-100
FF	-0.1	-0.1	0.0	0.0	0.0
Target(%)	-20	-40	-60	-80	-100
BR	-0.1	-0.1	-0.1	-0.2	-0.2
Target	2.25	2.00	1.75	1.50	
ITR	-0.1	-0.2	0.0	-0.2	
Target (%)	10	20	30	40	
CRR	-0.4	-1.2	-1.6	-2.1	
Target (%)	20	40	60	80	
TEC	-0.1				
Target (%)	-20	-40	-60	-80	
POL	-0.1	-0.1	-0.2	-0.4	
Target (%)	-20	-40	-60	-80	
PHY	-0.1	-0.1	-0.2	-0.2	

Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024. Colour indicates the magnitude of the deviation from the base value, with warmer colours (reds) showing larger negative deviations and cooler colours (blues) showing larger positive deviations.

Sector Weights

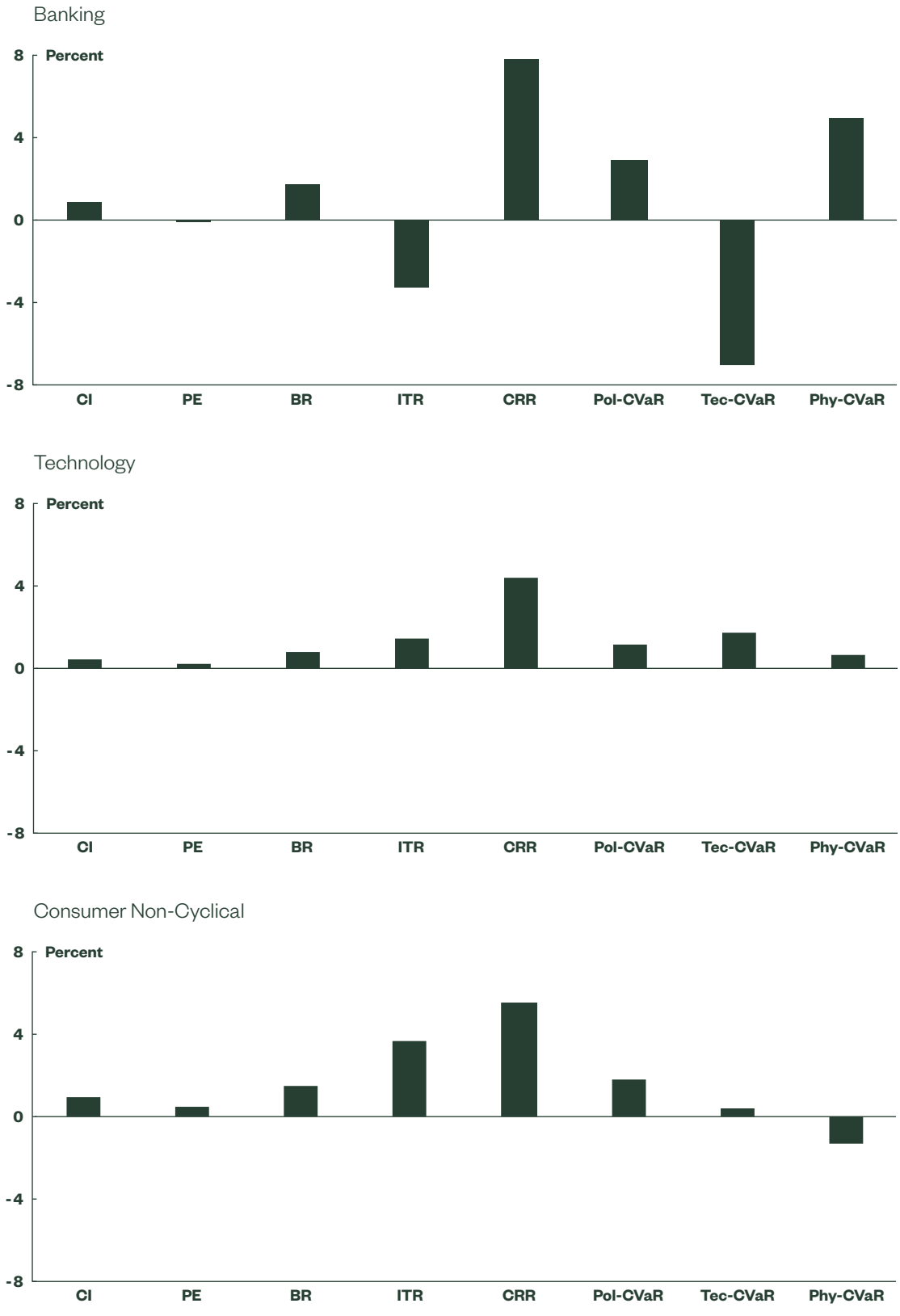
In this section, we present the average active weights of certain sectors. These are selected based on the average active weights across various metrics, as well as relative size within the index. For each target metric, we report the average active weight across the portfolios targeting improvement in that metric. For example, within the Energy chart, carbon intensity (CI) represents the average active weight to the Energy sector across the four CI improvement portfolios (-20%, -40%, -60% and -80%).

Figure 12
Average Active Sector Weights Across Selected Sectors (Bloomberg Class 3)



Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Figure 12
Average Active Sector Weights Across Selected Sectors (Bloomberg Class 3)
Continued



Source: State Street Global Advisors, Bloomberg, MSCI ESG Research, ISS-ESG, as of 31 May 2024.

Based on the portfolios and analysis, we make several observations:

- It may be possible to target improvements in multiple metrics simultaneously without taking on too much additional risk. Due to the correlated nature of the underlying climate metrics, hypothetical portfolios that target improvements in climate metric exposure also often resulted in improvements in other climate metrics. Notably, portfolios that target improvements in one out of the set of metrics — carbon intensity, potential emissions, brown revenues, ITR, and policy CVaR — also concurrently resulted in improvement in the other metrics, though the level of improvement varies.

- However, a side effect of such portfolios is that they also result in a worsening of the exposure to the Tech CVaR metric. This is further borne out by the results of the portfolios targeting an increase in Tech CVaR, which resulted in a worsening along all the other climate metrics. This indicates that it may be challenging to obtain simultaneous improvements in both the Tech CVaR as well as the other metrics.

- An interesting finding is that improvement in the Carbon Risk Rating appeared to improve the other metrics significantly as well (except Tech CVaR); however, this comes at the cost of a relatively higher tracking error and deviation in sector allocations.

- In general, the sector takeaways are not surprising and consistent with previous research. Carbon-intensive sectors like Energy, Utilities and Capital Goods tend to be underweighted by such portfolios, while Banking, Technology and Consumer Non-Cyclicals tend to be overweighted. There does appear to be a nuance related to Tech CVaR where the effects appear to be reversed (underweights to Banking, and overweights to Energy and Electric Utility).

- Looking at the performance tracking error impact of the portfolios which incorporate climate improvements versus the standard market weighted index, we found that, in general, higher climate improvement levels lead to higher tracking error. However, there does appear to be an "inflection point" for portfolio improvements in most metrics, where achieving the next level of improvement costs a lot more relative to the previous level. This is most visible for brown revenues (at -80 to -100%), Phy-CVaR (going from -60 to -80%), ITR (going from 1.75 to 1.5 degrees), and Carbon Risk Rating (going from 20% to 30%). On the level of tracking error itself, we note that portfolios which invested in investment grade rated bonds with performance tracking error above the 50 bps threshold were generally considered to be active investment strategies. For index investors in credit universes, the level of tracking error is typically constrained well below this threshold; as a result, many portfolios that tested above this threshold may prove to be impractical. Therefore, while small levels of improvement are possible at the lower end of the tracking error spectrum, larger and simultaneous improvements in the sustainability targets relative to the benchmark (particularly Tech CVaR) may prove to be challenging to achieve.

- Looking at the other portfolio characteristics, there are similar findings for the OAD, OAS and Index Rating, while the impact on yield appears to be relatively muted.

Conclusion

Given the increasing prevalence and availability of forward-looking climate data metrics in investment management, we studied a selection of the various types of datasets available in the market. We find that coverage in common fixed income universes is adequate in investment grade credits, while a bit lacking in high yield universes, necessitating missing value treatments.

We find that although the classification would suggest otherwise, some types of forward-looking metrics and backward-looking metrics are closely related to each other (notably, carbon intensity, potential emissions, brown revenues, ITR, and policy CVaR). At the same time, other types of forward-looking metrics (physical CVaR and Tech CVaR) appear to have a weaker or opposite relationship to backward-looking metrics and may contain complementary information.

We further find that portfolios that seek to improve against the index's climate profile may be able to achieve simultaneous improvements in multiple transition risk-related metrics, while also losing exposure to transition opportunities. This suggests that exposure to climate transition opportunities may need to be controlled separately. We conclude by suggesting the study of simultaneous improvements in risk and opportunity as an area for future research.

State Street Global Advisors: Integrating Climate Factors into Portfolio Construction

State Street Global Advisors' sustainable investing capabilities and solutions are driven by our commitment to partnering with our clients, as well as by our investment expertise, deep research, proprietary tools, and robust reporting, to give our clients the information they need to achieve their goals and invest with confidence.

Through our proprietary data and optimization models, we support clients with in-depth analysis to explore data coverage and the various trade-offs between tacking error and their desired sustainability objectives. Our multi-source data architecture, along with our own insights in the field of sustainable investing, facilitates flexibility in data application.

A common challenge implementers face is around the diversity of ambition and objectives investors have when it comes to investing propositions that integrate climate and transition related objectives. As such, investors typically require investment solutions that can be tailored to their requirements and an ability to be further modified over time. In our view, the ability of an asset manager to develop flexible and tailored solutions in today's dynamic, fast-changing world is crucial to meeting the variety of unique needs and risks investors face.

Endnotes

1 Shah, K., Cadbury, R. & Royer, A. (2025). Integrating forward-looking climate metrics in corporate fixed-income index portfolios.

2 Morningstar — Investing in Times of Climate Change (2024).

3 Delegated regulation — 2020/1818 — EN — EUR-Lex (europa.eu).

4 IIGCC-Enhancing-the-Quality-of-Net-Zero-Benchmarks.pdf (hubspotusercontent-eu1.net).

5 NZAOA_Development-and-Uptake-of-Net-Zero-Aligned-Benchmarks.pdf (unepfi.org).

6 Net Zero 2050 limits global warming to 1.5°C through stringent climate policies and innovation, reaching global net zero CO_2 emissions around 2050. This scenario assumes that ambitious climate policies are introduced immediately. Carbon dioxide removal is used to accelerate the decarbonisation but kept to the minimum possible and broadly in line with sustainable levels of bioenergy production. Net CO2 emissions reach zero around 2050, giving at least a 50% chance of limiting global warming to below 1.5°C by the end of the century, with limited overshoot (< 0.2°C) of 1.5°C in earlier years. Physical risks are relatively low but transition risks are high.

7 Carbon Risk Rating | ISS (issgovernance.com).

8 These indices were selected as they represent major segments of the global corporate bond market commonly used by institutional investors, covering both investment grade and high yield in the US dollar and euro markets. While other indices are available, this selection provides a comprehensive view of the market segments most relevant to our analysis.

9 Hypothetical portfolios are constructed for illustration purposes and do not depict actual portfolio characteristics.

10 Stratified sampling is a technique to build a portfolio comprised of physical securities with the same characteristics as the index using both quantitative and fundamental methods. This technique stratifies or divides an index into manageable risk elements (also called buckets) which the portfolio aims to match. The multiple dimensions of risk within a bond portfolio are commonly split as follows: currency, key rate duration, sector, credit rating, capital structure, issuer, and liquidity.

About State Street Global Advisors

For over four decades, State Street Global Advisors has served the world's governments, institutions, and financial advisors. With a rigorous, risk-aware approach built on research, analysis, and market-tested experience, and as pioneers in index and ETF investing, we are always inventing new ways to invest. As a result, we have become the world's fourth-largest asset manager* with US $4.72 trillion† under our care.

* Pensions & Investments Research Center, as of December 31, 2023.
†This figure is presented as of December 31, 2024 and includes ETF AUM of $1,577.74 billion USD of which approximately $82.19 billion USD in gold assets with respect to SPDR products for which State Street Global Advisors Funds Distributors, LLC (SSGA FD) acts solely as the marketing agent. SSGA FD and State Street Global Advisors are affiliated. Please note all AUM is unaudited.