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Systematic SDG Portfolios: Robust to Active Management, Regulatory Guidelines, and Open-Source Data?

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Systematic SDG Portfolios: Robust to Active Management, Regulatory Guidelines, and Open-Source Data?

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KEY FINDINGS

- The authors demonstrate that risk-efficient Sustainable Development Goals (SDG) portfolios can be constructed using traditional mean–variance optimization, despite significant variations in SDG score distributions across industries.
- To validate the robustness of these systematically constructed SDG portfolios, the authors conducted three tests. These assessments included comparisons with actively managed SDG portfolios, alignment with regulatory guidelines, and corroboration with open-source SDG data.
- This systematic approach allows investors to incorporate SDGs into their portfolios in a manner that is both risk-efficient and transparent.

ABSTRACT

This article explores the integration of the Sustainable Development Goals (SDGs) into systematic equity investment portfolios, underscoring the significance of SDG data in enabling investors to evaluate companies' alignment with sustainable development. The research demonstrates that systematic SDG portfolios can be effectively constructed using traditional mean–variance optimization, enhancing SDG profiles while managing active risk. We conduct three examinations of the portfolios, not directly incorporated within portfolio construction, to validate the robustness of the systematic and transparent SDG portfolio. These tests confirm the robustness of these portfolios through alignment with the views of actively managed SDG portfolios, guidelines (EU taxonomy and Paris-aligned benchmark exclusions), and open-source SDG data. The findings reveal the opportunity for investors to incorporate SDGs into their portfolios in a manner that is both risk-efficient and transparent.

The United Nations (UN) introduced the SDGs as a "blueprint to achieve a better and more sustainable future for all. They address the global challenges we face, including poverty, inequality, climate change, environmental degradation, peace and justice" (United Nations 2024b). There are 17 goals with 169 underlying targets, which specify a global understanding of sustainable development.[1] Although the SDGs were primarily designed for nations, sustainable investors are increasingly

[1] The number, name, and description of the 17 SDGs can be found in the Exhibit A1 in the Appendix, and the SDG number reference remains consistent throughout the article.

aligning their investment strategies with the UN's SDGs, with SDG funds growing from less than EUR 30 billion in January 2020 to EUR 74 billion in September 2023 (Balitzky and Mosson 2024).

CORPORATE INFLUENCE ON THE SDGS

The availability of SDG data is crucial for some investment strategies with sustainability goals. By integrating this data into their decision-making processes, investors can systematically evaluate and allocate to companies that align with their sustainability goals. To assist investors, data providers offer SDG data designed to assess the influence companies have on the SDGs, typically through their products and services (what they do) and their operations (how they do it). This perspective on how companies can influence the SDGs is consistently reflected across academia, investor groups, data frameworks, and data providers.

In academic discourse, van Zanten and van Tulder (2021a) assert that companies engage with the SDGs through their operational activities and the goods and services they provide. Pedersen (2018) discusses the concept of *SDG un-fit* products and business practices, and Schramade (2017) highlights how investors can gauge a company's contribution to the SDGs based on the nature of its products and its efforts to understand the influence of its business model and operations on the SDGs.

Among investor groups, the Principles for Responsible Investment (PRI) emphasizes the importance of identifying both positive and negative real-world outcomes related to investees' operations, products, and services (Jeucken, Whitley, and Fabian 2020). The PRI's Impact Investing Map employs this approach to assess influences on broader societal objectives (Principles for Responsible Investment 2018). The Global Investors for Sustainable Development (GISD) Alliance uses a decision tree to evaluate company impact, with the first layer focusing on business activities and the second on business practices and operations. GISD (2020) suggests that negative influences from products or services cannot be mitigated by stronger business practices. A study commissioned by GISD corroborates this definition, revealing that major commercial data providers measure companies' SDG contributions on two levels: through products and services, and through sustainable business conduct (Bassen et al. 2021).

Regarding data frameworks, the Global Reporting Initiative (GRI) and the UN Global Compact (2018) have developed a practical guide to SDG reporting, which prioritizes SDG-related products, services, and investments, and the influences of operations and value chains. The European Financial Reporting Advisory Group (EFRAG) defines impact materiality as the effects on people and the environment associated with an entity's operations and value chain, including its products, services, and business relationships (Danes et al. 2023). The GRI (2021) advises organizations to consider influences directly linked to their operations, products, or services through their business relationships.

In the realm of data creators, we consider perspectives from both conventional data providers and asset managers who generate datasets. Entities such as MSCI, ISS, Robeco, SDI AOP, Inrate, Moody's, Sustainalytics, and Impact Cubed all incorporate both product/service and operational aspects. These entities address these aspects in various ways, such as aggregating them into scores or providing raw data, and they incorporate controversies differently. For example, MSCI includes controversies in their operation scoring approach, whereas ISS treats controversies as a distinct pillar. Ultimately, although there are differences, there is meaningful overlap in methodology and intention of the data.[2]

[2] More details on the SDG ratings construction methodology may be found on the vendors' websites.

LITERATURE ASSESSING SDG DATA AND PORTFOLIOS

When assessing the outputs of SDG data and SDG portfolios, we find relevant research in four key areas:

1. Properties of SDGs scores and how they differ from ESG scores
2. Theoretical underpinnings on why SDGs should be understood from a nexus perspective rather than in isolation
3. Whether SDG scores make sense
4. How SDG data can be utilized in portfolios

SDGs Scores and How They Differ from ESG Scores

Environmental, social, and governance (ESG) ratings generally assess whether a company's profitability is at risk due to sustainability factors, rather than evaluating how companies influence societies and the environment (Popescu, Hitaj, and Benetto 2021). These ratings are primarily concerned with financial materiality, which focuses on the economic implications of a company's sustainability practices. For instance, ESG ratings might consider how well a company manages environmental risks that could affect its financial performance, such as regulatory compliance or resource efficiency.

Bassen et al. (2021) further illustrate that ESG assessments are largely driven by operational activities, such as a company's internal policies and procedures aimed at mitigating environmental and social risks. In contrast, the SDGs emphasize social and environmental outcomes regardless of their financial materiality. Robeco (2022) supports this view within their data, stating that the products or services provided by companies are a more significant determinant of the total SDG score, as these are perceived to be the primary means through which companies impact the world.

The biases inherent in ESG scores are widely recognized. Large companies tend to score better than smaller companies (Artiach et al. 2010; Gallo and Christensen 2011; Drempetic, Klein, and Zwergel 2020; Akgun, Mudge, and Townsend 2021; Dobrick, Klein, and Zwergel 2023). Similarly, firms in developed markets generally score better than those in emerging markets (Wang, Ho, and Vitell 2012; Arminen et al. 2018), as they typically operate in environments with stricter regulatory requirements and greater stakeholder pressure for sustainability.

Additionally, companies with greater resources for providing ESG data tend to earn above-average ratings (Drempetic, Klein, and Zwergel 2020). This does not necessarily imply that these companies have superior sustainability performance, but rather that they are better equipped to report on their sustainability efforts. He, Lohre, and van Zanten (2024) note that Robeco SDG scores do not suffer from the same biases, or at least not to the same extent, as ESG scores. This suggests that SDG assessments may focus more on the contributions to societal and environmental goals rather than the ability to report on them.

An SDG Nexus Approach

One area in which data providers differ is in the aggregation across the SDGs. Although corporate products, services, and operations can help understand influences toward individual SDGs, an aggregated perspective is both challenging and helpful for the portfolio construction process.

The question of how to aggregate influences toward the SDGs is important. The United Nations emphasizes that all sustainable objectives must go hand in hand, ensuring that no one is left behind (United Nations 2024a). Given the complex and interconnected nature of the SDGs (Nilsson, Griggs, and Visbeck 2016;

Griggs et al. 2017), the literature often refers to a *nexus* approach (Agyeman, Bullard, and Evans 2002; Bhaduri et al. 2015; Boas, Biermann, and Kanie 2016; Liu et al. 2018; van Zanten and van Tulder 2020; van Zanten and van Tulder 2021a; van Zanten and van Tulder 2021b; Estoque 2023) to treat sustainability goals collectively, rather than in silos that may ignore interaction affects and the bigger picture.

To address the SDGs collectively within corporate SDG datasets, an aggregation of positive and negative impacts toward each SDG, without allowing for positive and negative influences to offset each other, can be applied. This style of approach has been proposed by MSCI for individual SDGs when combining operational and product/service interactions, and by van Zanten et al. (2023) and van Zanten (2025) when combining across the SDGs. This methodology also shares similarities with the EU principle of *do no significant harm* (European Securities and Markets Authority 2023), the definition of sustainable investments by the European Union (2019), and the precautionary principle in environmental science (Kriebel et al. 2001).

Do SDG Scores Make Sense?

Van Zanten and Huij (2022) suggest that SDG scores appear to align with the sustainability preferences of asset owners and seem to be consistent with the EU taxonomy. Their findings indicate that companies with very high emissions generally receive lower scores, which reflects the views of climate scientists who emphasize the importance of reducing greenhouse gas emissions to combat climate change.

A further study by van Zanten (2025) critically examines the alignment between ESG ratings and SDG scores, with a particular focus on the comparative performance of MSCI and Robeco's SDG assessments.

The analysis reveals a fundamental disconnect between ESG ratings and SDG scores. Specifically, the study finds no statistically significant correlation between the two, suggesting that ESG ratings do not reliably reflect companies' actual contributions to sustainable development. This finding challenges the prevailing assumption that ESG metrics can serve as effective proxies for corporate sustainability influence.

In comparing SDG scores from MSCI and Robeco, the study identifies only a modest correlation ($r = 0.39$), indicating limited agreement between these two providers. This is similar to findings by Bauckloh et al. (2024) on SDG scores and findings of ESG score divergence (Kotsantonis and Serafeim 2019; Billio et al. 2020; Dimson, Marsh, and Staunton 2020; Berg, Kölbel, amd Rigobon 2022; Bender et al. 2023). This divergence underscores the methodological inconsistencies and subjective judgments embedded in current SDG scoring frameworks, raising concerns about the comparability and reliability of such metrics across providers.

The study claims that SDG scores exhibit greater construct validity than ESG ratings. That is, SDG scores more accurately capture stakeholder perceptions of corporate impacts—both positive and negative—on sustainable development outcomes. This suggests that SDG scores may offer a more meaningful lens through which to assess corporate sustainability performance.

The author concludes that ESG ratings, SDG scores, and broader corporate sustainability assessments represent distinct yet complementary constructs. As such, investors and policymakers are advised to avoid conflating these measures and instead to adopt a more integrated approach that leverages the unique insights each framework provides.

How SDG Data Is Incorporated into Portfolios

It is well documented that ESG information can be integrated into equity portfolios by approaches ranging from indexing to active management (e.g., Bender et al. 2018).

Meanwhile portfolios constructed using SDG principles can differ significantly from those based on ESG criteria (De Franco, Nicolle, and Tran 2021; Bams and van der Kroft 2025).

When it comes to incorporating SDG data into investment portfolios, recent research from Impact Cubed (2024) and Blitz et al. (2024) demonstrates how SDG data can be systematically incorporated into investment portfolios using the same mean–variance optimization framework as in constructing factor or ESG portfolios. Similarly, we employ the mean–variance optimization framework to design an SDG model portfolio that aims for benchmark-alike returns through minimizing tracking error while simultaneously improving both the aggregate SDG score and key environmental and social SDGs and controlling the active allocations by security, sector, and country. This approach allows for the integration of SDG-related data into the portfolio construction process, balancing the trade-offs between risk, return, and the SDGs.

Research Goal

Our objective is to contribute to the existing literature by combining and extending the third and fourth areas of research noted previously: evaluating the robustness of systematic equity portfolios constructed using SDG data. We believe this is an important step, given data often do not seamlessly transition from a signal to effective implementation within real-world long-only portfolios. This can be driven by liquidity, long-only constraints (Jacobs, Levy, and Starer 1999) and more.

DATA

Multiple data sources and methods of aggregation can be employed to assess SDG alignment. Each source and method offers unique insights and perspectives, aiming to understand a company's influence toward the SDGs.

In this example, we utilize MSCI's SDG alignment data as our primary source. The MSCI SDG alignment methodology transforms raw data into aggregated SDG scores through a structured process. Initially, we collect data from various sources, including MSCI ESG Research's core products such as sustainable impact metrics, ESG controversies, and ESG ratings. Examples of raw data points include the percentage of a company's revenue derived from products and services that contribute to specific SDGs.

Companies are then evaluated based on their products and services (product alignment) and their operational practices (operational alignment). Each company receives scores for its alignment with the 17 SDGs, reflecting both positive and negative contributions. These individual scores are subsequently aggregated to form an overall SDG net alignment score for each SDG, which is also expressed in categories ranging from strongly aligned to strongly misaligned. This process aims to provide a comprehensive assessment of a company's contributions to the SDGs.

Following the collection of MSCI's SDG alignment data, we apply an aggregation method similar to that used by van Zanten et al. (2023) and van Zanten (2025) to consolidate the data across the various SDGs. This approach involves evaluating both positive and negative influences of a company's activities on each SDG, allowing for an approach in which negative SDG influences cannot be offset by positive alignment elsewhere, applying the spirit of a nexus approach. Companies that have a score ranging from –10 to –2 on any of the 17 SDGs are assigned the lowest (minimum) score as their total SDG score. Conversely, those that do not have a score in this range receive the highest (maximum) score as their total SDG score. This method

is one of many ways in which raw data can be transformed into an aggregated SDG score for use in investment portfolios.

The flowchart in Exhibit 1 outlines this process in detail, providing a visual representation of the steps involved. It illustrates how raw SDG alignment data are collected, processed, and aggregated to produce a final SDG score. This score can then be used within systematic equity portfolios.

In Exhibit 2, we provide an example to illustrate how this aggregation method works in practice (the numbers, names, and descriptions of the 17 SDGs can be found in the appendix). Consider a solar energy company whose primary business activity is in alternative energy technology. This company has successfully reduced its energy consumption year over year, demonstrating a commitment to sustainability and efficiency.

Despite these positive strides, however, there are allegations of forced labor associated with its operations. This example highlights the complexity of aggregating SDG data, as it requires balancing positive contributions with significant negative influences to provide a comprehensive assessment of the company's overall alignment with the SDGs.

The outcomes of this process indicate that, in aggregation (Exhibit 3), the majority of companies exhibit some alignment with the SDGs. Less than 5% of companies are assessed to be strongly aligned, however. These strongly aligned companies typically provide direct solutions toward the SDGs, such as alternative energy—SDG 7 (affordable and clean energy), SDG 12 (responsible consumption and production), SDG 13 (climate action)—or major disease treatment—SDG 1 (no poverty), SDG 3 (good health and well-being). Notably, these strongly aligned companies are distributed across various global industry classification standard (GICS) sectors and different

EXHIBIT 1

Data Aggregation Method Flowchart

Data Inputs

- What companies produce (products and services measured by revenues)
- How companies produce (operational data including controversies)

Score Companies Against Each SDG

- Raw data aggregated to assess individual SDGs

Aggregate SDG Level Scores into One Score

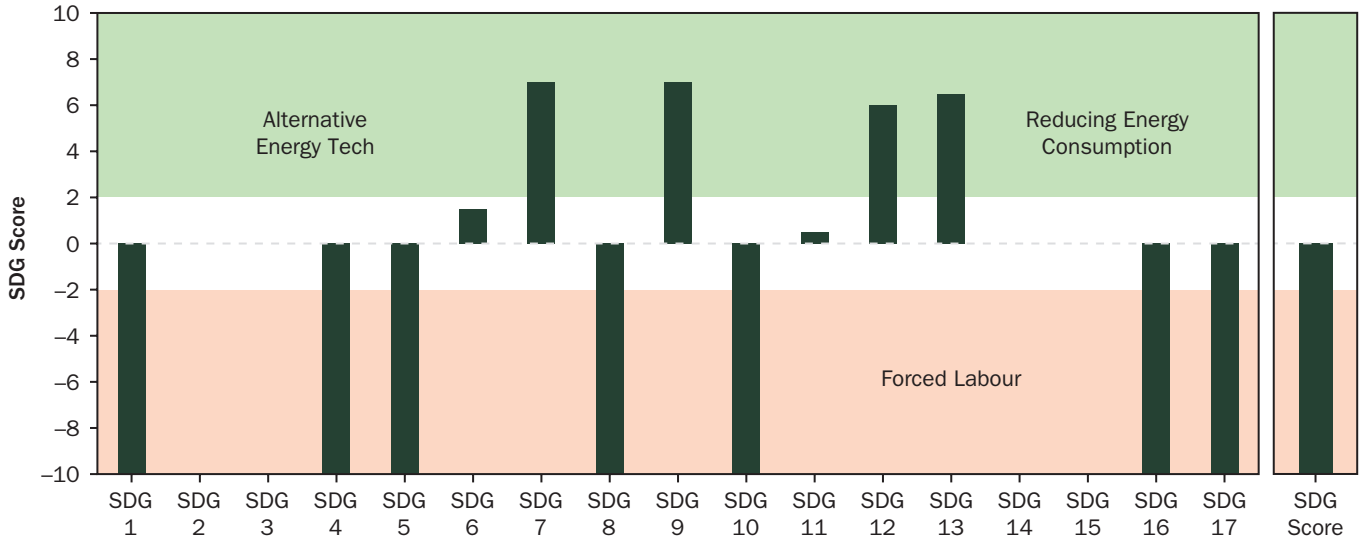
- Non-linear aggregation doesn't allow misalignment with the SDGs to be offset with strong performance against another

NOTE: Chart for illustrative purposes.

SOURCE: State Street Investment Management.

EXHIBIT 2

Data Aggregation Example

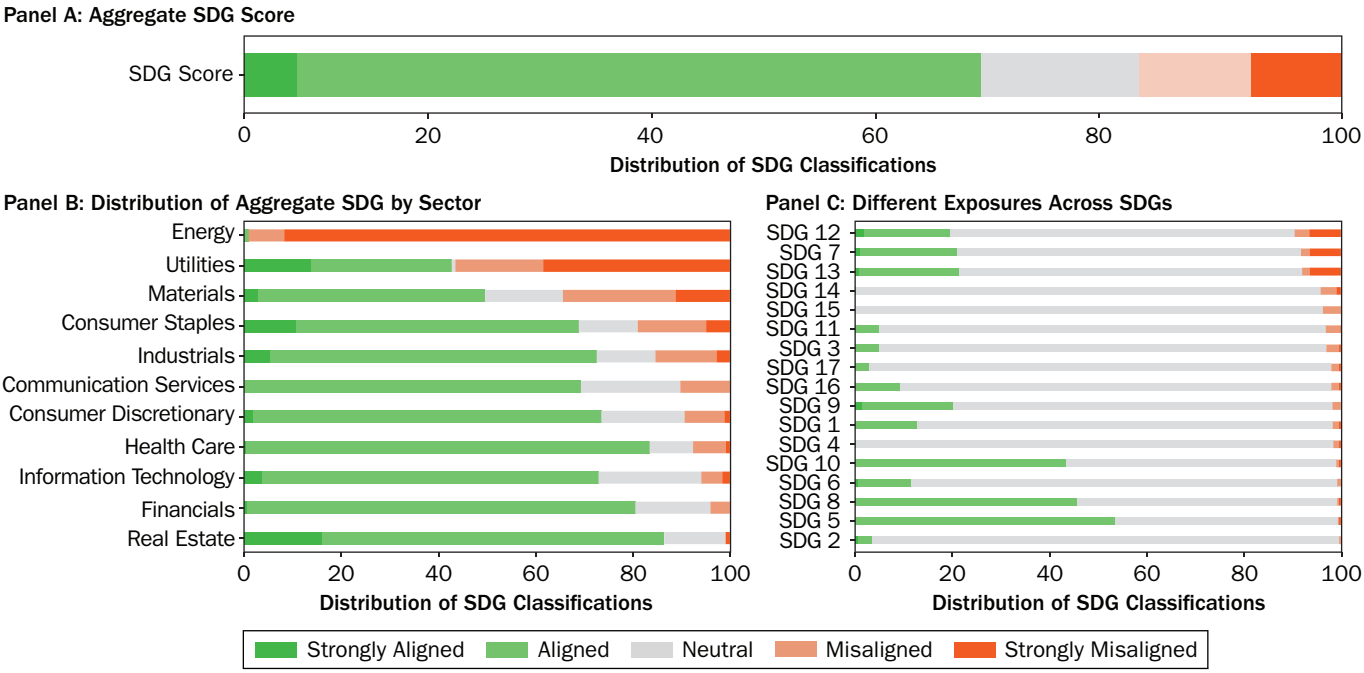


NOTES: Data as of July 2024. This exhibit for illustrative purposes. This information should not be used or construed as an offer to sell, a solicitation of an offer to buy, or a recommendation for any security.

SOURCES: State Street Investment Management and MSCI.

EXHIBIT 3

SDG Data Distribution



NOTES: Data based on the MSCI ACWI Universe. Data as of July 2024.

SOURCES: State Street Investment Management and MSCI.

SDGs, rather than being concentrated in a specific market segment or aligning with only a small subset of SDGs.

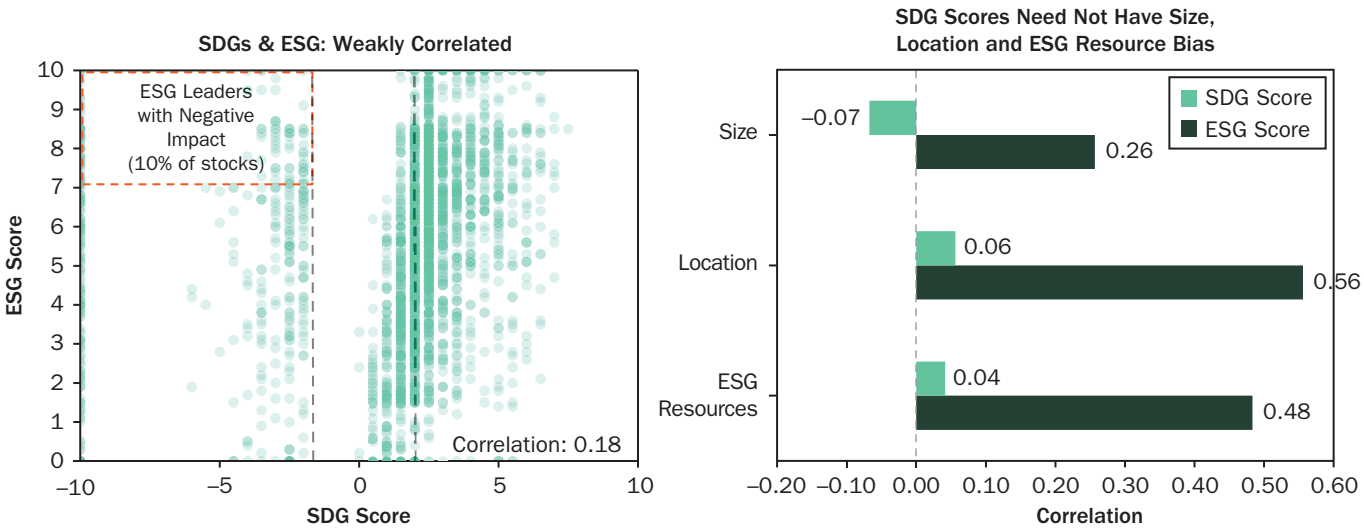
In contrast, 8% of companies are strongly SDG misaligned, with an additional 10% being deemed misaligned. The strongly misaligned companies are more concentrated in certain sectors compared with the strongly aligned companies. For instance, the majority of energy companies within the MSCI All Country World Index, which are predominantly fossil fuel companies, are deemed strongly misaligned. The utilities sector is divided between fossil fuel–based and more environmentally friendly power generation, with the fossil fuel–based companies being strongly SDG misaligned. Given the fossil fuel nature of some of these businesses, companies in the energy and utilities sectors are commonly misaligned with SDG 7 (affordable and clean energy), SDG 12 (responsible consumption and production), and SDG 13 (climate action). Additionally, tobacco companies in the consumer staples sector are shown to be misaligned with SDG 3 (good health and well-being), highlighting a more socially focused SDG misalignment.

As noted earlier, there are conceptual differences between ESG scores and SDG scores. In practice, these differences become evident through the weak correlation between MSCI ESG scores and the aggregated SDG scores (Exhibit 4). For instance, 10% of stocks that are considered ESG leaders exhibit negative SDG alignment (Exhibit 4). This discrepancy highlights the distinct criteria and focus areas of each scoring system.

Furthermore, similar to the findings of He, Lohre, and van Zanten (2024), the aggregated SDG scores do not exhibit the same biases related to company size, location, or ESG resourcing that are often present in ESG scores (Exhibit 4). This suggests that SDG scores may provide a more balanced assessment of a company's SDG influence, free from the influence of these common biases. This adds further robustness to the initial findings from He, Lohre, and van Zanten (2024).

EXHIBIT 4

SDG and ESG Data: Biases and Relations



NOTES: Data based on the MSCI ACWI Universe. Data as of July 2024. Size is proxied by the log of total assets, location by being developed or emerging markets, and ESG resources being those companies that disclose to CDP. This analysis follows a similar approach to He et al. (2024).

SOURCES: State Street Investment Management and MSCI.

BUILDING AN SDG PORTFOLIO

We construct hypothetical portfolios designed to align with the SDGs while maintaining a risk-controlled approach. The goal is to maintain an active risk-controlled portfolio while making meaningful improvements in the SDG profile.

Our starting point is the MSCI World Index, although this framework can be applied to other underlying universes as well. We then optimize this universe to minimize tracking error and transaction costs, ensuring alignment with the SDGs on a weighted average basis, targeting an aggregated SDG score of two or higher—the level MSCI deems to be SDG aligned.

To achieve a balanced representation across the SDGs, we impose constraints on a collection of social and environmental SDGs. This prevents the optimizer from focusing on just a small subset of goals. Additionally, we constrain active sector, country, currency, and stock weights to encourage the selection of best-in-class companies and limit active sector risk.

The resultant portfolio maintains an ex ante tracking error of 48 basis points, with limited active country and sector weights, while preserving similar levels of concentration (Exhibit 5). This approach leads to an overall improvement in the aggregate SDG score, as well as enhancements across each individual SDG.

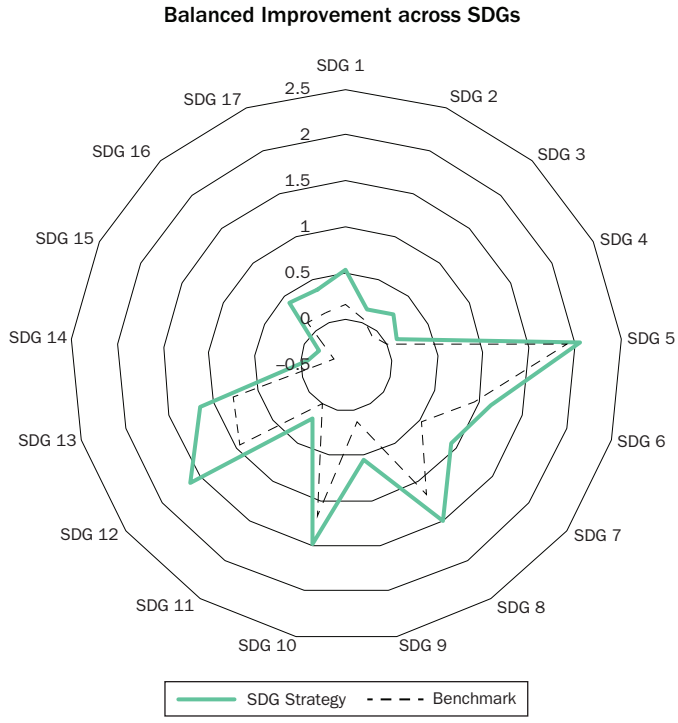
It is interesting to note that the ability to gain greater active exposure to some SDGs compared with others is influenced by the number of companies and their respective weights within the universe being used for portfolio construction. For instance, within the MSCI World, there are relatively few companies either aligned

EXHIBIT 5

SDG Portfolio Outcomes

Low Active Exposures, Similar Concentration		
	Benchmark	SDG Portfolio
Ex-Ante Tracking Error (bps)	0	48
Predicted Beta	1	0.9975
Active Share (%)	0	28.24
Sector Active Share (%)	0	2.73
Country Active Share (%)	0	2.04
Stock Count	1409	799
Effective Number of Stocks	108	113
Weight in Top 10 Stocks (%)	23.59	22.47
Weight in Top 50 Stocks (%)	41.3	40.77

Sustainability Improvements		
	Benchmark	SDG Portfolio
SDG Score	0.44	2.01
Environmental SDGs	0.06	1.5
Social SDGs	0.12	1.5
MSCI ESG Score	6.94	7.2
Carbon Intensity	98.35	89.18
Brown Revenues	5.14	3.2
Green Revenues	8.4	10.1



NOTES: Data as of September 2024. Data based on the MSCI World Universe.

SOURCES: State Street Investment Management, Axioma, and MSCI.

or misaligned with SDG 4 (quality education), resulting in only minor improvements. In contrast, there are significantly more companies aligned or misaligned with SDG 12 (responsible consumption and production). This allows for more substantial improvements by underweighting or excluding the least-aligned companies and overweighting those most aligned.

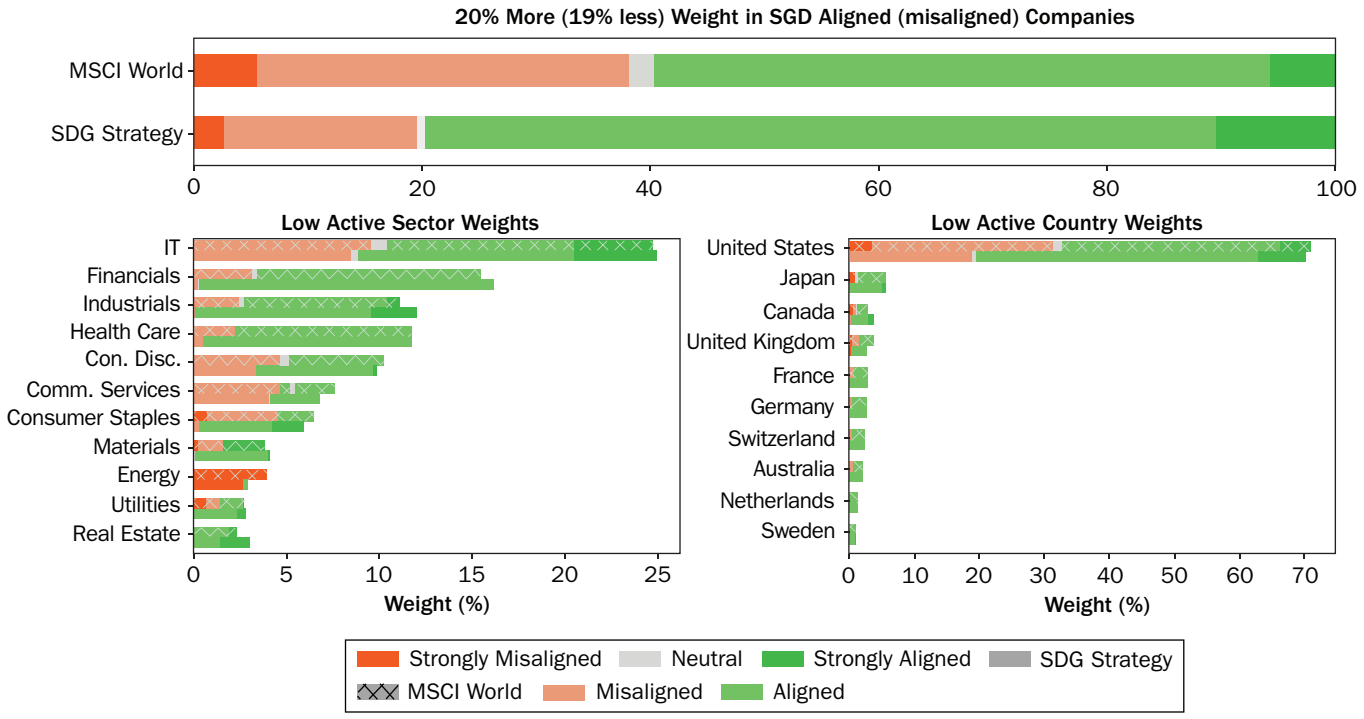
When we view the SDGs in aggregation, the SDG strategy effectively halves the weight of misaligned companies while doubling the weight of strongly aligned stocks. Upon closer examination, we observe notable differences both between and within sectors (Exhibit 6).

In the industrials sector, there is an overweight of 1%, achieved by reducing the almost 3% weight in SDG-misaligned companies and significantly increasing the weight of strongly aligned companies. Examples of these strongly aligned companies include railways aligned with SDG 9 (industry, innovation, and infrastructure), water technology solutions aligned with SDG 6 (clean water and sanitation), and wind turbine manufacturers aligned with SDG 7 (affordable and clean energy). This is an example of the sector constraint helping to select the best-in-class names, rather than simply allocating away.

The energy sector is underweighted by 1%, which is the maximum underweight allowed under the applied sector constraints. These constraints help mitigate active sector risk, which can lead to significant cyclical differences in returns relative to a benchmark over prolonged periods. Due to these constraints, there is a substantial reduction in the weight of strongly misaligned energy companies, from nearly 4% to 2.6%. Conversely, the weight of the small aligned portion of the sector increases tenfold, from 2.9 basis points to 29 basis points.

EXHIBIT 6

Improvements in SDG Exposures



NOTES: Data as of September 2024. Data based on the MSCI World Universe. This exhibit for illustrative purposes.

SOURCES: State Street Investment Management, Axioma, and MSCI.

In the real estate sector, there is an overweight of 40 basis points, with allocations directed toward companies that have significant exposure to affordable real estate aligned with SDG 1 (no poverty) and green buildings aligned with SDG 11 (sustainable cities and communities) and SDG 12 (responsible consumption and production). This strategic allocation ensures a balanced representation across the SDGs while focusing on SDG influential companies within the sector.

PORTFOLIO ROBUSTNESS TESTS

In the realm of portfolio optimization, it is important to recognize that although theoretically any dataset can be optimized to construct a portfolio, this does not necessarily translate to practical utility for investors. The true value of a portfolio lies in its relevance and alignment with investor goals.

To understand the robustness of our SDG portfolios, we consider three objective measures that are external to the portfolio itself (Exhibit 7), in which each of these tests require certain assumptions.

Firstly, we evaluate the portfolio by comparing it against the holdings of actively managed SDG funds. This yardstick can provide insight into how the simulated SDG portfolio stands relative to those managed by experienced professionals in the field.

Secondly, the portfolio is assessed against elements of the principles of adverse impact and the EU taxonomy. This regulatory framework aims to ensure that the portfolio adheres to stringent environmental, social, and governance (ESG) criteria, thereby aligning with broader sustainability goals.

Lastly, we utilize open-source data, specifically from Robeco, to further validate the portfolio. This independent data source offers an additional layer of transparency and accountability, potentially reinforcing the portfolio's alignment with recognized sustainability metrics.

Active Managers Test

To conduct our analysis, the first step is to understand active SDG portfolio manager preferences, building a revealed preference measure. Revealed preference theory is used in multiple fields (Richter 1966; John et al. 2008; Blocher and Molyboga 2017),

EXHIBIT 7

Portfolio Robustness Tests

Portfolio Test	Description	Assumptions for Validity of Test
1. Active Managers	Assess portfolio against the holdings of actively managed SDG funds	• Active portfolio managers can well assess corporate alignment with the SDGs • Active portfolio managers aim to allocate toward companies aligned with the SDGs within SDG labelled funds
2. Regulators	Assess portfolio against elements of the principles of adverse impact and the EU Taxonomy	• Regulators, and the scientists that have informed them, are able to, and desire to, build regulation that accurately reflects corporate impact toward the SDGs • Data utilized well captures the regulation
3. Open-Source Data	Assess portfolio against open source Robeco data	• Robeco data is robust in design and implementation

NOTE: This exhibit for illustrative purposes.

SOURCE: State Street Investment Management.

including sustainable finance (van der Beck 2023). This measure allows us to dig into investor preferences through their actions, from the perspective of stock ownership.

To construct this measure, we begin by downloading data on SDG portfolios. These portfolios are sourced from Morningstar, are listed in Europe, and contain SDG or SDG-related terms within their names or descriptions. We then manually verify each portfolio to remove false positives.

Next, we aggregate these verified portfolios into an *aggregate active SDG portfolio* by summing the value invested in each stock across all these portfolios. This aggregation provides a comprehensive view of the total investment in each stock within the SDG-focused portfolios and allows us to understand the aggregate positioning of these funds.

We then map the aggregate active portfolio to the MSCI World Index to establish a benchmark for comparison. To identify the *preferred* stocks within the aggregate active portfolio, we perform the following calculations:

1. Absolute active weight: For each stock, we calculate the absolute active weight as the difference between its weight in the aggregate active SDG portfolio and its weight in the MSCI World Index (Equation 1).

   Equation 1: Absolute active weight (AAW).

$$AAW_{AASDG} = W_{AASDG} - W_{wld} \tag{1}$$

where W_{AASDG} is the weight of the stock in the aggregate active SDG portfolio, and W_{wld} is the weight of the stock in the MSCI World Index.

2. Relative active weight: For each stock, we calculate the relative active weight as the ratio of its weight in the aggregate active SDG portfolio to its weight in the MSCI World (Equation 2).

   Equation 2: Relative active weight (RAW).

$$RAW_{AASDG} = \frac{W_{AASDG}}{W_{wld}} \tag{2}$$

3. Number of portfolios holding each stock: We calculate the percentile rank of each stock based on the number of SDG portfolios that hold it (Equation 3).

   Equation 3: Stock held (SH).

$$SH_{AASDG} = \sum_{i=1}^{n} 1_{\{x \in P_i\}} \tag{3}$$

Here, $1_{\{x \in P_i\}}$ is the indicator function that equals one if the stock x is included in the SDG portfolio P_i, and zero otherwise. The summation counts the number of SDG portfolios that hold stock x.

For each stock, we then calculate the *preferred stocks score* by taking the mean of its percentile ranks from the three measures above. Mathematically, this can be expressed as:

Equation 4: Preferred stocks score (PPS).

$$PPS_{AASDG} = \frac{P_{AAW} + P_{RAW} + P_{SH}}{3} \tag{4}$$

where P_{AAW} is the percentile rank based on absolute active weight, P_{RAW} is the percentile rank based on relative active weight, and P_{SH} is the percentile rank based on the number of portfolios holding the stock.

Finally, we select the top 50 stocks by their preferred stocks score as the *preferred stocks* (PS).

This selection process allows us to understand which stocks are preferred by active portfolio managers in the sample, taking into account nuances of building real world portfolios that commonly need to account for liquidity, tracking error, and more. For example, a portfolio may hold a very strong view on one of the smallest stocks in the benchmark, that is one of the least liquid, and subsequently own the stock at a relatively small weight, but at a large multiplier of its benchmark weight (e.g., a 40-bp holding of a stock with 1 bp of weight in the index). Whereas, they may choose a relatively small absolute overweight for a large stock in multiplier terms to avoid overly concentrating the portfolio, but in absolute terms the active weight is far larger than that on the smaller name (e.g., a 200-bp holding of a stock with 150 bps of weight in the benchmark).

To evaluate the SDG portfolio relative to active managers, two distinct methods can be employed.

The first method is a straightforward analysis that involves examining the cumulative active weight of the stocks identified as preferred. This approach provides a simple overview by aggregating the active weights of these preferred stocks, allowing for a direct comparison with the active managers' portfolios.

The second method is more nuanced and involves a regression-based analysis. This approach consists of running two sets of regressions. The first set of regressions aims to explain the absolute active weight of the portfolio. In this context, the absolute active weight refers to the total deviation of the portfolio's holdings from the benchmark weights. The second set of regressions focuses on explaining the relative active weight.

In both sets of regressions (Equation 5 shows the final form of the regression model with all variables), the preferred stocks designation is used as a dummy variable. This means that the presence of a preferred stock is represented by a binary variable (one if the stock is preferred, zero otherwise). By including this dummy variable, the analysis can isolate the effect of holding preferred stocks on the active weights.

Additionally, variations of these regressions are conducted to control for other factors that might influence the active weights. These factors include country-specific effects, industry classifications, and style factors such as value and momentum. By controlling for these variables, the analysis can provide a more nuanced understanding of the relationship between the SDG portfolio and the active managers' portfolios.

This detailed approach allows for a comprehensive evaluation of the SDG portfolio, considering both simple aggregate measures and more sophisticated statistical analyses that account for various influencing factors.

Equation 5: Final regression model for the active managers test.

$$Active\ Weight_i = \beta_0 + \beta_1 PS_i + \beta_2 Country_i + \beta_3 Industry_i + \beta_4 Style_i + \varepsilon_i \quad (5)$$

where $Active\ Weight_i$ is either the absolute or relative active weight, and PS_i is a dummy variable that equals one if stock i is a preferred stock, and zero otherwise. $Country_i$ represents the country-specific effects for stock I; $Industry_i$ represents the industry classification for stock I; $Style_i$ includes variables for style factors for stock I; β_0, β_1, β_2, β_3, β_4 are the coefficients to be estimated; and ε_i is the error term.

Regulators

When assessing alignment with regulatory standards, we have focused on two fundamental components of EU regulation. The first component is the PAB (Paris-aligned benchmark) exclusions, which are utilized as part of the Paris-aligned benchmarks and have also been recently incorporated into the ESMA (European Securities and Markets Authority) naming guidance. These exclusions are expected to be critical in ensuring that the portfolio adheres to the stringent criteria set forth by these benchmarks.

The second component is the EU taxonomy, which provides a comprehensive framework for classifying economic activities that contribute to environmental objectives. This taxonomy incorporates three key financial metrics: revenue, operating expenditures (OPEX), and capital expenditures (CAPEX). The revenue metric is backward-looking, reflecting past financial performance. OPEX is current, representing ongoing operational costs, whereas CAPEX is forward-looking, indicating future investments.

In our research approach, we adopt a methodology similar to that used for evaluating active managers. Firstly, this involves analyzing active exposures toward each regulatory component. Secondly, we employ a regression-based approach (Equation 6) to gain deeper insights. Unlike the analysis of active managers, in which we use the preferred stocks as a dummy variable, in this context, we use binary classifications to represent whether companies meet specific thresholds. These thresholds include having more than 25% of their revenue, OPEX, or CAPEX aligned with the EU taxonomy, as well as meeting the PAB exclusions criteria.

Equation 6: Final regression model for the regulators test.

$$Active\ Weight_i = \beta_0 + \beta_1 Regulation_i + \beta_2 Country_i + \beta_3 Industry_i + \beta_4 Style_i + \varepsilon_i \qquad (6)$$

where $Regulation_i$ is a dummy variable for any of the regulatory datasets: EU taxonomy based or PAB exclusions.

Open-Source Data

In our study, we utilized open-source data obtained from Robeco. The data were collected on a stock-by-stock basis from the Robeco website, which implies that our dataset does not encompass the entire universe of stocks but is limited to specific companies for which data were available.

We conducted an analysis similar to that described in Equation 4, focusing this time on the relative and absolute weight between the SDG portfolio and the MSCI World Index, as outlined in Equation 7. From this analysis, we selected the top 25 and bottom 25 stocks to test. These stocks represent those most and least preferred within the SDG portfolio, respectively, and are the companies for which we collected data from Robeco.

Equation 7: Preferred stocks score (PPS).

$$PPS_{SDG} = \frac{P_{AAW} + P_{RAW}}{2} \qquad (7)$$

where P_{AAW} is the absolute active weight between the SDG portfolio and the MSCI World, and P_{RAW} is the relative active weight.

Our analysis comprised two distinct approaches. Firstly, we examined the median Robeco SDG scores for the most and least favored stocks. This involved calculating the median SDG score for the top 25 stocks (most preferred) and the bottom 25 stocks (least preferred) within the SDG portfolio. This approach allowed us to

understand the central tendency of SDG scores among the most and least favored stocks.

Secondly, we employed a regression-based approach (Equation 8). In this method, we used the 50 stocks for which data were collected from Robeco (the most and least preferred within the SDG portfolio) and regressed the SDG scores on a dummy variable indicating whether the stock was overweighted in the SDG portfolio (i.e., most preferred stock). Additionally, we controlled for sector and country dummy variables to understand the robustness of our findings. This regression analysis enabled us to quantify the relationship between the SDG scores and the preference status of the stocks within the SDG portfolio, while accounting for potential confounding factors related to sector and country.

By employing these two analytical approaches, we aimed to provide a comprehensive understanding of the SDG scores for the most and least preferred stocks within the SDG portfolio, and to identify any significant patterns or relationships that may exist between stock preference and corporate SDG influence, as measured by Robeco.

Equation 8: Final regression model for the active managers test.

$$SDG\ Score_i = \beta_0 + \beta_1 Overweight_i + \beta_2 Country_i + \beta_3 Sector_i + \varepsilon_i \quad (8)$$

where $SDG\ Score_i$ is the SDG score for company i, $Overweight_i$ is a dummy variable for whether the company is overweighted in the SDG Portfolio (i.e., most preferred stock), and $Sector_i$ is a dummy variable for the GICS sector company i belongs to.

Portfolio Outcomes Robustness Tests Results

We began by conducting a simpler analysis across each of the tests before delving into the regression analysis to uncover further nuances. This initial step allowed us to establish a foundational understanding of the data and identify any immediate patterns or trends.

From our observations, as illustrated in Exhibit 8, we noted several key findings:

Firstly, there is a meaningful alignment between the stocks preferred by active managers and those that are overweighted in the portfolio. This suggests that the preferences of active managers are reflected in the composition of the SDG portfolio, indicating a level of consistency in stock selection criteria.

Secondly, the SDG portfolio exhibits greater exposure to the EU taxonomy across various financial metrics, including revenue, CAPEX, and OPEX. Conversely, it has less exposure to PAB exclusions.

Thirdly, the SDG strategy's preferred stocks have a positive median Robeco SDG score, which Robeco defines as SDG aligned. In contrast, the least preferred stocks within the SDG strategy have a negative median Robeco SDG score. This differentiation highlights a level of robustness of the SDG strategy in selecting stocks that align with the SDGs even when utilizing an alternative data source to measure, and avoiding those that do not meet these criteria.

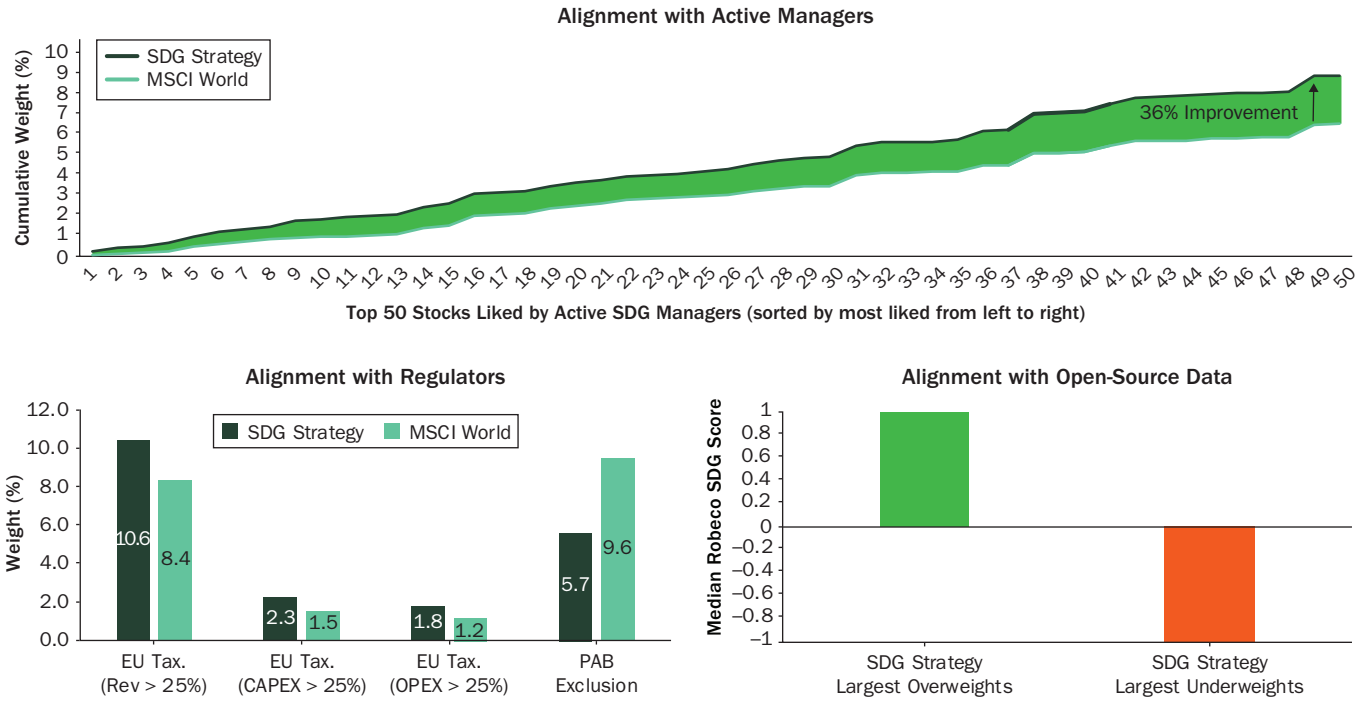
Overall, through a relatively simplistic lens, the SDG portfolio appears to be at least somewhat aligned with the preferences of active SDG portfolio managers, regulators, and open-source data.

To further explore the alignment with active managers, we conducted a detailed examination of the additional weight assigned to the SDG stocks preferred by these managers (Exhibit 9). Our analysis revealed a strong statistically significant relationship between the stocks favored by active managers and both their absolute and relative active weight within the portfolio.

Our observations indicate that the regression models assessing the relative active weight increase exhibit stronger explanatory power compared with those

EXHIBIT 8

Portfolio Passes Robustness Tests



NOTES: The Open-Source data is based on SDG scores powered by Robeco. Data based on the MSCI World Universe. Data as of September 2024. This exhibit for illustrative purposes.

SOURCES: State Street Investment Management, Axioma, MSCI, and Robeco.

evaluating the absolute active weight. This finding supports our hypothesis implied by Equations 5 and 8, that considering active weight alone does not adequately account for factors in constructing real-world portfolios, such as liquidity and being long only, that can limit the ability to take large active positions in absolute terms, on the least liquid names.

Furthermore, on a relative basis, we estimate that the average preferred stock holds a weight between approximately 1.7 to 1.9 times the benchmark weight in the SDG portfolio, after accounting for other risk factors. This represents an economically meaningful overweight, as well as being statistically significant. We also find a statistically significant overweight in absolute terms.

These relationships remained consistent even when we applied controls for country, industry, and style. By incorporating these controls, we ensured that our findings were not influenced by external factors such as geographical location, industry-specific trends, or investment styles. This consistency indicates that active SDG portfolio managers tend to take specific stock positions that can be effectively replicated using a data-driven, systematic approach. This finding underscores the potential for systematic strategies to mirror the stock selection preferences of active managers.

Our analysis reveals a strong statistically significant and economically meaningful relationship between the EU taxonomy revenues, CAPEX, and OPEX, and the relative active weight within the SDG portfolio, as illustrated in Exhibit 10. This relationship holds true even when we control for industries, countries, and investment styles.

EXHIBIT 9

Alignment with Active Managers

Y = SDG Portfolio Weight-Bench. Weight	Model 1	Model 2	Model 3	Model 4	Model 5
Active Manager Liked	0.0005***	0.0005***	0.0005***	0.0006***	0.0006***
R-Squared[a]	0.02	0.02	0.02	0.05	0.05
N.Obs[b]	1405	1405	1405	1405	1405
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes

Y = SDG Portfolio Weight/Bench. Weight	Model 6	Model 7	Model 8	Model 9	Model 10
Active Manager Liked	0.7134**	0.7648***	0.7994***	0.8729***	0.8921***
R-Squared	0	0.05	0.05	0.03	0.11
N.Obs	1405	1405	1405	1405	1405
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes

NOTES: This exhibit represents regression output from a cross-sectional regression model in which the Y variable in the top chart is the SDG strategy weight/benchmark weight, and in the bottom chart is the active weight within the State Street Investment Management SDG strategy. The X variables are active manager liked, which is a dummy variable, with one representing the most liked companies. Industry control and country control represent dummy variables for the GICS industry and country of domicile. Style control represents dividend yield, earnings yield, exchange rate sensitivity, growth, leverage, liquidity, market sensitivity, medium term momentum, profitability, size, value, and volatility from the Axioma medium horizon fundamental risk model. Data based on the MSCI World Universe. Data as of September 2024. Chart for illustrative purposes. [1]*R*-squared (R^2 or the coefficient of determination) is a statistical measure in a regression model that determines the proportion of variance in the dependent variable that can be explained by the independent variable. In other words, *R*-squared shows how well the data fit the regression model (the goodness of fit). It ranges from zero to one, where one indicates a perfect fit of the model to the data and zero is the opposite. [2]N.obs stands for number of observations. *, ** and *** represent significance level at 10, 5 and 1%.

SOURCES: State Street Investment Management, Axioma, and Morningstar.

When examining absolute weights, however, we do not observe the same significant relationship with EU taxonomy, CAPEX, and OPEX. This discrepancy may be attributed to the complexities involved in constructing real-world portfolios, such as the constraints of long-only strategies and liquidity considerations. Additionally, the limited number of companies that have disclosed these specific data points may have impacted our ability to assess this relationship comprehensively.

When examining the open-source data, we observe that, without any controls, there is an economically meaningful and statistically significant difference in SDG scores between stocks that are underweighted and those that are overweighted in the SDG portfolio. The Robeco data, which is scaled from –3 to 3, shows an estimated difference of 1.4 in SDG scores between these two groups of stocks, as shown in Exhibit 11.

When we control for sectors and countries, however, the significance of the overweighted names dummy variable drops to the 10% level. This reduction in significance may be attributed to the small sample size and the numerous factors being controlled for, which result in only 22 degrees of freedom. Increasing the sample size in future studies may help address these issues and improve the robustness of the results.

Although the coefficient is not drastically different, the reduced significance level does impact the robustness of our findings.

Overall, we find strong evidence to suggest robust systematic SDG portfolios can be built in alignment with actively managed SDG portfolios and regulatory standards (specifically the EU taxonomy and PAB exclusions). We also find evidence to suggest alignment with open-source data from Robeco.

EXHIBIT 10

Alignment with Regulators

Weight	Revenue Model 1	Revenue Model 2	Revenue Model 3	Revenue Model 4	Revenue Model 5
Y = SDG Portfolio Weight/Bench					
Revenue	2.1733***	2.0594***	2.2460***	2.2031***	2.2181***
R-Squared	0.07	0.11	0.11	0.09	0.17
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes
Weight	**CAPEX Model 1**	**CAPEX Model 2**	**CAPEX Model 3**	**CAPEX Model 4**	**CAPEX Model 5**
Y = SDG Portfolio Weight/Bench					
CAPEX	1.3664***	1.4611***	1.2787***	1.3564***	1.5711***
R-Squared	0.02	0.07	0.06	0.04	0.13
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes
Weight	**OPEX Model 1**	**OPEX Model 2**	**OPEX Model 3**	**OPEX Model 4**	**OPEX Model 5**
Y = SDG Portfolio Weight/Bench					
OPEX	1.2372***	1.2622***	1.1279***	1.2434***	1.3194***
R-Squared	0.01	0.06	0.05	0.04	0.12
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes
Weight	**PAB Model 1**	**PAB Model 2**	**PAB Model 3**	**PAB Model 4**	**PAB Model 5**
Y = SDG Portfolio Weight/Bench					
PAB Exclusion	–0.8011***	–0.9477***	–1.7461***	–1.0730***	–1.8090***
R-Squared	0.02	0.07	0.08	0.05	0.14
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes
Weight	**Revenue Model 1**	**Revenue Model 2**	**Revenue Model 3**	**Revenue Model 4**	**Revenue Model 5**
Y = SDG Portfolio Weight – Bench					
Revenue	0.0003***	0.0003***	0.0003***	0.0003***	0.0003***
R-Squared	0.01	0.01	0.01	0.03	0.04
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes
Weight	**CAPEX Model 1**	**CAPEX Model 2**	**CAPEX Model 3**	**CAPEX Model 4**	**CAPEX Model 5**
Y = SDG Portfolio Weight – Bench					
CAPEX	0.0002	0.0002	0.0002	0.0002	0.0002*
R-Squared	0	0.01	0.01	0.02	0.03
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes

(continued)

EXHIBIT 10 *(continued)*

Alignment with Regulators

Weight	OPEX Model 1	OPEX Model 2	OPEX Model 3	OPEX Model 4	OPEX Model 5
Y = SDG Portfolio Weight – Bench					
OPEX	0.0002	0.0002	0.0002	0.0002	0.0002
R-Squared	0	0.01	0.01	0.02	0.03
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes
Weight	**PAB Model 1**	**PAB Model 2**	**PAB Model 3**	**PAB Model 4**	**PAB Model 5**
Y = SDG Portfolio Weight – Bench					
PAB Exclusion	–0.0003***	–0.0003***	–0.0006***	–0.0003***	–0.0005***
R-Squared	0.02	0.02	0.03	0.04	0.05
N.Obs	1380	1380	1380	1380	1380
Country Control	No	Yes	No	No	Yes
Industry Control	No	No	Yes	No	Yes
Style Control	No	No	No	Yes	Yes

NOTES: This exhibit represents regression output from a cross-sectional regression model in which the Y variable is either the relative weight of companies or the absolute weight difference within the State Street Investment Management SDG strategy. The X variables represent a dummy variable for whether the company has over 25% of their revenues, whether CAPEX or OPEX align with the EU taxonomy, or whether the stock is excluded under PAB requirements. Industry control, country control, and style control represent dummy variables for the GICS industry, country of domicile, and common style factors. Data as of September 2024. This exhibit for illustrative purposes. *, ** and *** represent significance level at 10, 5 and 1%.

SOURCES: State Street Investment Management and MSCI.

EXHIBIT 11

Alignment with Open Source Data

Y = Robeco SDG Score	Model 1	Model 2	Model 3	Model 4
Overweight	1.4400***	1.3105**	1.5609***	1.2880*
R-Squared Adj.	0.1641	0.3783	0.3349	0.5383
N.Obs	50	50	50	50
Sector Control	No	No	Yes	Yes
Country Control	No	Yes	No	Yes

NOTES: This exhibit represents regression output from a cross-sectional regression model in which the Y variable is the Robeco SDG score for the top 25 overweights and top 25 underweights within the State Street Investment Management SDG strategy. The X variable overweight is a dummy variable, with one representing the company being in the top 25 overweights and zero in the top 25 underweights. Sector control and country control represent dummy variables for the GICS sector and country of domicile. The open-source data is based on SDG scores powered by Robeco. Data as of September 2024. This exhibit for illustrative purposes. *, ** and *** represent significance level at 10, 5 and 1%.

SOURCES: State Street Investment Management and Robeco.

CONCLUSIONS

In conclusion, this article has surveyed the increasing adoption of SDG strategies by investors, reflecting a significant shift toward aligning investment practices with the United Nations' SDGs. This trend is supported by a growing body of research that explores various aspects of SDG integration into investment strategies.

Firstly, the research highlights the differences between ESG scores and SDG scores. Whereas ESG ratings primarily assess the financial materiality of a company's sustainability practices, SDG scores focus on the social and environmental outcomes, regardless of their financial implications.

Secondly, the research emphasizes the importance of a nexus approach to the SDGs. This approach advocates for treating sustainability goals collectively rather than in isolation, recognizing the interconnected nature of the SDGs. By aggregating positive and negative influences without offsetting them, investors can gain a more comprehensive understanding of a company's contributions to sustainable development.

Thirdly, the research examines whether SDG scores make sense and how they can be utilized in investment portfolios. Studies suggest that SDG scores align with the sustainability preferences of asset owners and are consistent with frameworks such as the EU taxonomy. This alignment indicates that SDG scores may offer a more accurate reflection of a company's influence on societal and environmental goals compared with ESG ratings.

Our research builds on these foundations by evaluating the robustness of systematic equity portfolios constructed using SDG data. This in our view is a natural evolution from the work of van Zanten (2025), which assessed the suitability of SDG scores in meeting investor requirements. We find it may be possible to construct risk-controlled SDG portfolios with meaningfully different SDG profiles. These portfolios could show improvements in SDG alignment while limiting active risks and incentivizing stocks to be compared with those that are best in class.

To validate the robustness of these portfolios, we conducted several tests. Firstly, we compared the SDG portfolios with actively managed SDG portfolios, finding a strong alignment in stock selection preferences. Secondly, we assessed the portfolios against regulatory guidelines, specifically the EU taxonomy and Paris-aligned benchmark (PAB) exclusions, confirming their compliance with stringent sustainability criteria. Lastly, we validated the portfolios using open-source SDG data from Robeco, further reinforcing their alignment with recognized sustainability metrics.

Overall, this article provides evidence that robust systematic SDG portfolios can be constructed in alignment with actively managed SDG portfolios, regulatory standards, and open-source SDG data.

APPENDIX

The 2030 Agenda for Sustainable Development, adopted by all United Nations member states in 2015, lays out 17 Sustainable Development Goals as follows, and the article follows the same numbering order.

EXHIBIT A1

SDG Number, Name, and Description

SDG#	Goal	Description
1	No poverty	End poverty in all its forms everywhere.
2	Zero hunger	End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
3	Good health and well-being	Ensure healthy lives and promote well-being for all at all ages.
4	Quality education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
5	Gender equality	Achieve gender equality and empower all women and girls.
6	Clean water and sanitation	Ensure availability and sustainable management of water and sanitation for all.
7	Affordable and clean energy	Ensure access to affordable, reliable, sustainable, and modern energy for all.
8	Decent work and economic growth	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
9	Industry, innovation, and infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
10	Reduced inequalities	Reduce inequality within and among countries.
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient, and sustainable.
12	Responsible consumption and production	Ensure sustainable consumption and production patterns.
13	Climate action	Take urgent action to combat climate change and its impacts.
14	Life below water	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development.
15	Life on land	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.
16	Peace, justice, and strong institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable, and inclusive institutions at all levels.
17	Partnership for the goals	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

SOURCE: United Nations (2024b).

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