

# What's wacky about your WACI?

By Jean Zhou and Kushal Shah

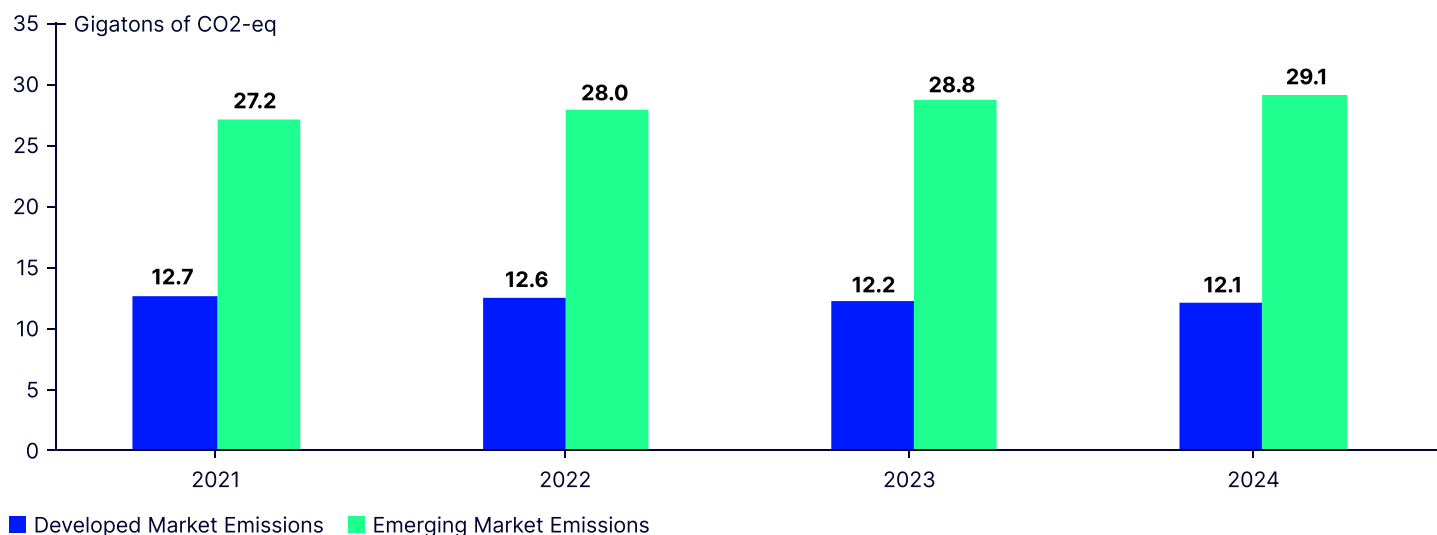
In recent years, some investors with climate-related objectives have adopted portfolio decarbonization goals.<sup>1,2</sup> Often, such portfolios target metrics such as the weighted average carbon intensity (WACI), carbon footprint, financed emissions intensity, and others. With the adoption of such targets, investors may wish to better understand the drivers of change in the targeted portfolio emissions metrics against the benchmark at a given point in time or over a period of time. While it may be easy to assume that changes in the portfolio WACI come from the actual and absolute emissions by the underlying portfolio companies, other drivers could include normalization factors, market movements, and portfolio turnover.

Some methodological approaches have been developed in the industry to help attribute these changes in portfolio metrics.<sup>3</sup> In this article, we utilize one such emissions attribution framework,<sup>4</sup> and apply it to three commonly used equity and fixed income indexes to understand the drivers of WACI change over a three-year period between December 2022 and December 2025.<sup>5</sup> We also demonstrate how this framework can be extended to analyze the WACI drivers at a sectoral level.

## Global greenhouse gas (GHG) and WACI trends

First, we look at broad trends in global GHG emissions over the recent years where data is available. We observe that aggregate GHG emissions (excl. LUCF)<sup>6</sup> from developed market (DM) countries have declined approximately 4.6% from the year 2021 to 2024 based on emissions from Our World in Data.<sup>7</sup> On the other hand, aggregate emissions from emerging market (EM) countries have increased by 7.1% over that same period.

**Figure 1: Total GHG emissions by developed and emerging markets (Gt CO2e)**



Source: State Street Investment Management analysis, GHG emissions from Our World in Data. Data as at 8 June 2026. For illustrative purposes only. Developed Markets (DM) and Emerging Markets (EM) Emissions include emissions from countries that form part of the S&P Developed LargeMidCap Index (25 countries) and S&P Emerging LargeMidCap Index (23 countries) respectively. Figures exclude emissions due to Land-Use Change and Forestry (LUCF).

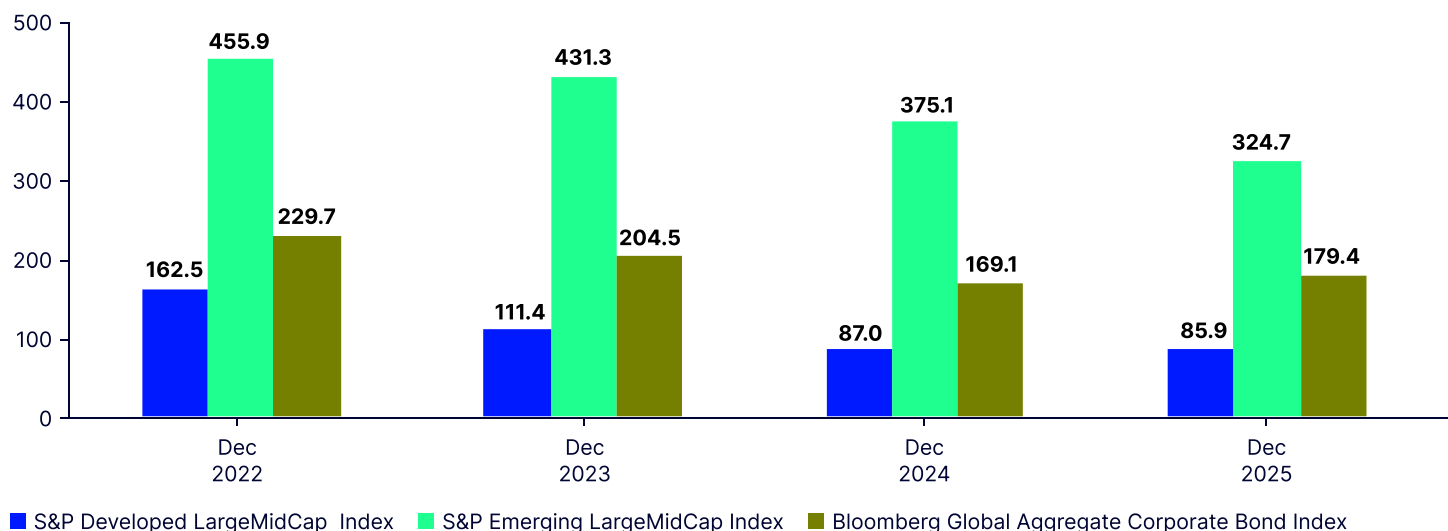
Turning to investable indexes, Figure 2 shows the weighted average carbon intensity (Scope 1 and 2 normalized by revenues)<sup>8</sup> of selected indexes. In particular, we find that between December 2022 and December 2025, based on emissions data from ISS:

- S&P Developed LargeMidCap Index's WACI reduced from 162.5 to 85.9, a reduction of 47.1%;

- S&P Emerging LargeMidCap Index's WACI reduced from 455.9 to 324.7, a reduction of 28.8%;
- Bloomberg Global Aggregate Corporate Bond Index's WACI reduced from 229.7 to 179.4, a reduction of 21.9%.

**Figure 2: Index weighted average carbon intensity, December 2022 to December 2025**

Index Weighted Average Carbon Intensity—Scope 1+2 / Revenue



Source: State Street Investment Management, S&P, ISS, Bloomberg. Data as at 8 June 2026. Data for illustrative purposes only. WACI is calculated on the same, comparable basis for all three indexes as the index-weighted average of constituent carbon intensity (Scope 1+2 emissions/revenue), consistent with the TCFD definition.

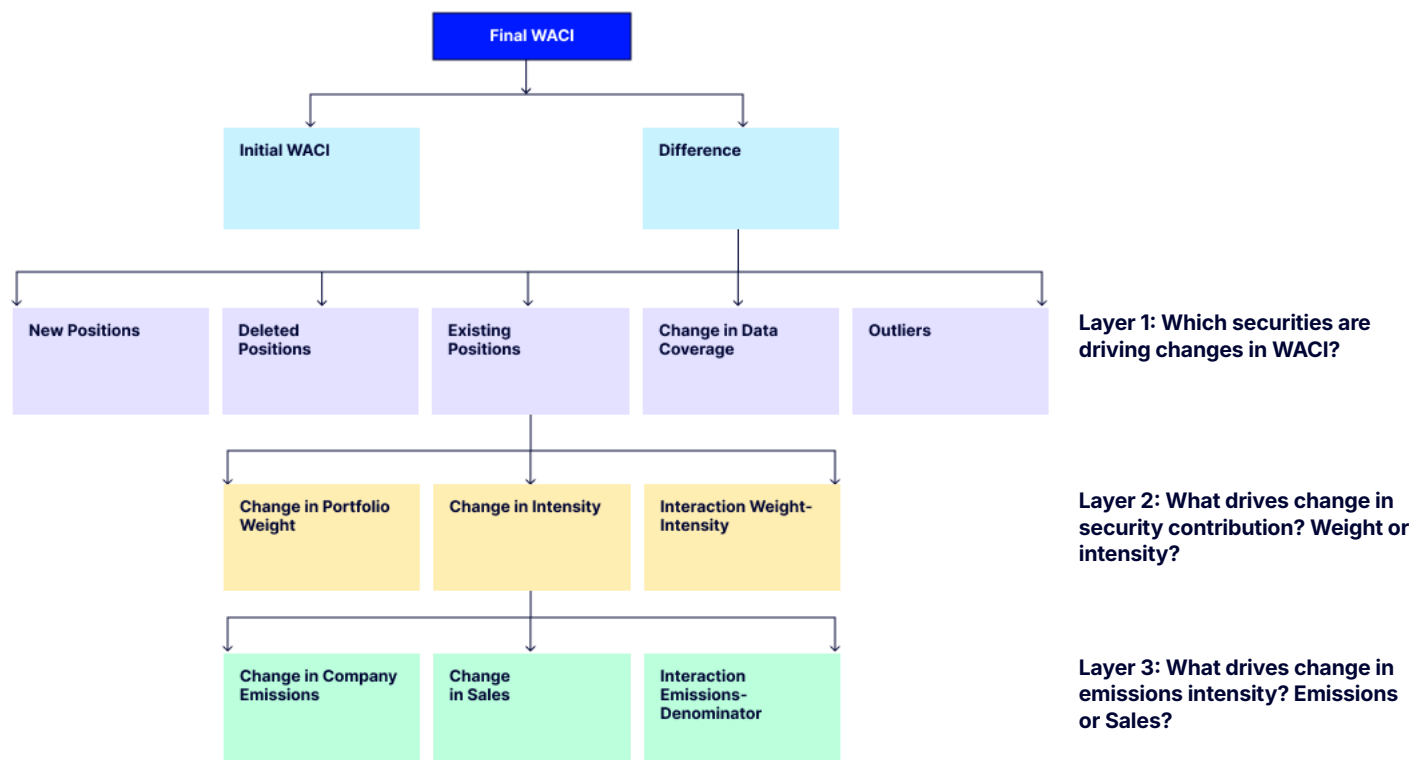
We note that the index WACI can be driven by various factors including changes in company emissions, normalization factors, market movements, and index changes. Additionally, it is interesting to observe that while total national emissions in DM and EM have declined slightly or increased in the latest available three-year period, the WACI of the regional indexes considered here have reduced significantly. This divergence can seem puzzling to many, and reinforces the need for having a framework which can break down WACI changes into various potential drivers, given institutional investor focus and allocation to such indexes.

Overview of the Carbon Attribution Framework

As noted above, the industry has developed some approaches to analyzing the drivers of changes in portfolio emissions metrics. These approaches—ranging from partial equilibrium methods to multi layer attribution structures—are often designed to be flexible to accommodate differences in various data sources and carbon metrics (absolute or intensity based). They provide a general structure for distinguishing the driving factors while highlighting the importance of data quality and coverage boundaries.<sup>9</sup>

To further understand the drivers of the change in index WACI, we utilize the carbon attribution framework described by Nagy et al.<sup>10</sup> with a slight modification to consider outlier treatment,<sup>11</sup> outlined in Figure 3.

Figure 3: Carbon Attribution Framework (Full)



Source: State Street Investment Management, Nagy et al.

This framework is a hierarchical three-layered analysis that seeks to explain the factors contributing to changes in WACI.

It begins with the difference between the Final WACI (for example, as of 2025) and the Initial WACI (for example, as of 2022). This difference is first broken down in Layer 1, which identifies the types of portfolio positions influencing the change—namely, New Positions, Deleted Positions, Existing Positions, Change in Data Coverage, and Outliers.

Layer 2 explores what drives the change in each security's contribution to WACI, distinguishing between changes in portfolio weight, emissions intensity, and the interaction between the two (i.e., the effect of both weight and intensity changing simultaneously).

Layer 3 goes further to analyze what causes changes in emissions intensity itself, attributing it to either changes in company emissions (numerator), the change in sales (denominator) used in the intensity calculation and the interaction between the two (i.e., the effect of both emissions and sales changing simultaneously).

There are also parallels between this framework (particularly at Layers 2 and 3) and the Brinson attribution framework often used to dissect sectoral allocation, selection and interaction effects. There can be several advantages of using this framework:

- It can help investors understand and attribute the drivers of WACI between changes in real-world emissions, portfolio changes or denominator effects.
- It can be flexibly applied to different portfolios, asset classes and time periods.
- It can be utilized for different types of emissions statistics (absolute or intensity) and normalization factors (sales, EVIC or market cap).
- It can also be used to delve deeper by applying it to different classification schemes within portfolios (e.g., sectors or regions).

At the same time, there may be several drawbacks that investors should consider when using this approach:

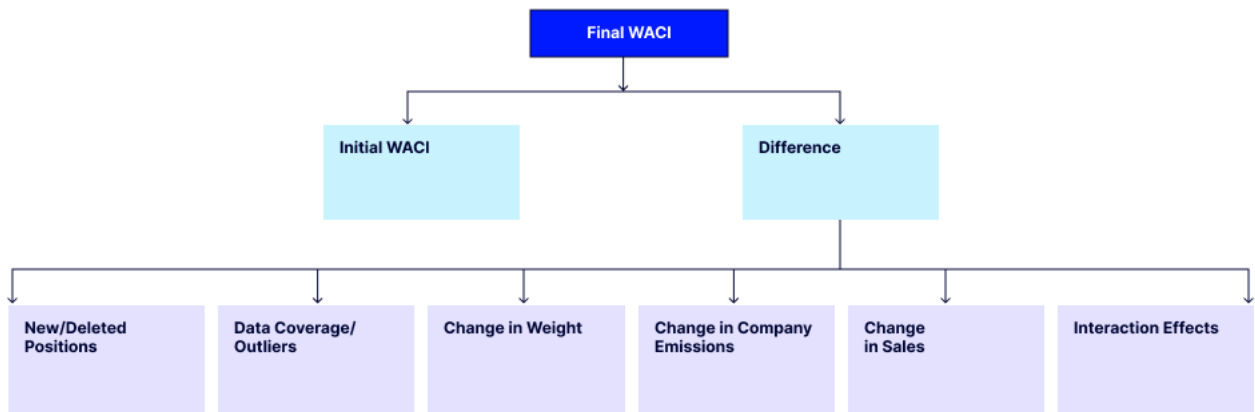
- The accuracy of the attribution depends heavily on the availability and reliability of emissions data, which can vary significantly across regions and/or sectors.
- The analytical framework is complex and may necessitate expert interpretation.
- The second and third layers focus on securities that remain in the portfolio over the period analyzed. This may reduce applicability for portfolios with higher turnover.
- The interaction terms in the second and third layers can be challenging to interpret.
- Double counting effects between Scope 1 and Scope 2 emissions are not accounted for.<sup>12</sup>

Several of the limitations identified arise from the inherent complexity of emissions data and reporting frameworks, including issues such as data quality and the potential for double counting. While these considerations provide essential context, they are likely to influence any analysis of portfolio emissions. Therefore, in our view, this approach remains one of the more robust approaches currently available.

Furthermore, this article introduces sector-level breakdown enhancements designed to provide a more granular view of the data and to clarify the underlying interaction drivers.

For the purposes of clear visualization, we use a simplified version of this framework by combining some terms and bringing all the various terms into a single layer (Figure 4). In Layer 1, we merge “New Positions” and “Deleted Positions” into a single category—“New/Deleted Positions”—and group “Change in Data Coverage” and “Outliers” under “Data Coverage/Outliers.” We replace the “Existing Positions” term with its underlying terms from Layers 2 and 3. In essence, we divide this term into “Change in weight,” “Change in company emissions,” and “Change in sales,” and introduce a unified “Interaction Effects” category to encapsulate the previously separate interaction terms (one each in Layers 2 and 3). This reorganization helps enhance clarity and analytical efficiency by focusing attention on what we view to be the most influential factors driving WACI variation.

Figure 4: Carbon Attribution Framework (Simplified)

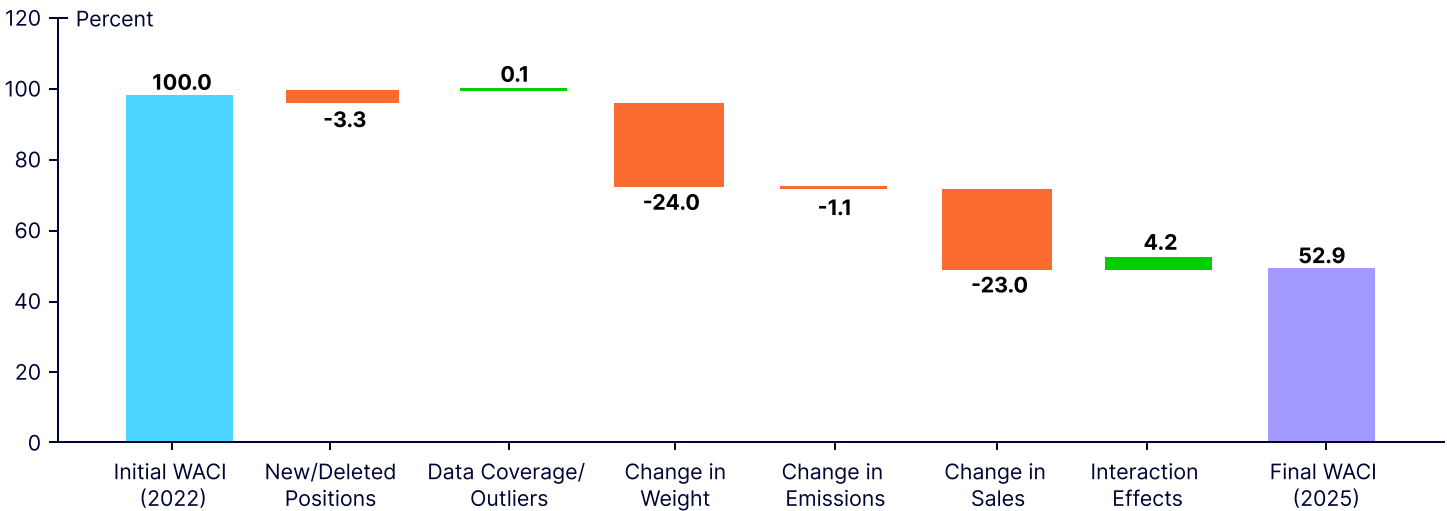


Source: State Street Investment Management.

We now apply this simplified framework to the S&P Developed LargeMidCap Index, the S&P Emerging LargeMidCap Index and the Bloomberg Global Aggregate Corporate Bond Index. We also extend this

framework to various Global Industry Classification Standard (GICS) sectors in the S&P Developed LargeMidCap Index.

Figure 5: WACI Drivers in S&P Developed LargeMidCap Index  
S&P Developed LargeMidCap Index—WACI Drivers (as a % of 2022 WACI)

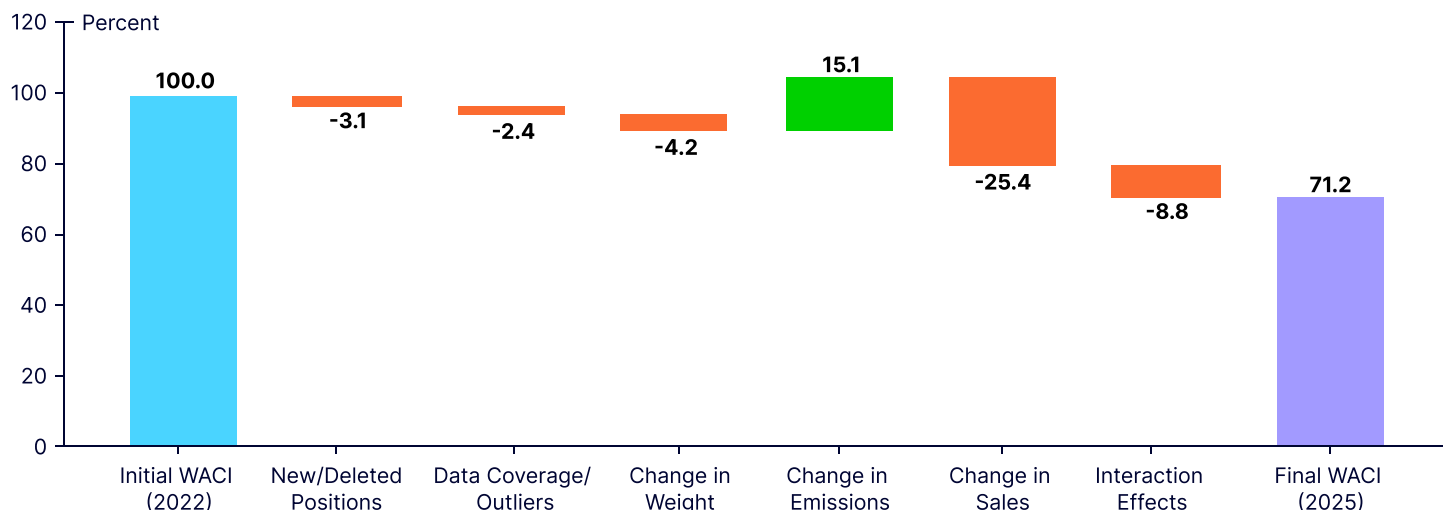


Source: State Street Investment Management, S&P, ISS. Data as at 8 June 2026.

The WACI of the S&P Developed LargeMidCap Index declined by 47.1% between December 2022 and December 2025. Measuring each driver against the 2022 WACI (set at 100%), higher sales reduced the WACI by 23 percentage points, lower portfolio weights by 24 points (i.e., reduced weights in holdings that had

a higher WACI than the initial portfolio), new or deleted positions by 3.3 points, and lower carbon emissions by 1.1 points. These reductions were partly offset by interaction effects, which added 4.2 points. Other drivers had a minimal effect.

**Figure 6: WACI Drivers in S&P Emerging LargeMidCap Index**  
S&P Emerging LargeMidCap Index—WACI Drivers (as a % of 2022 WACI)

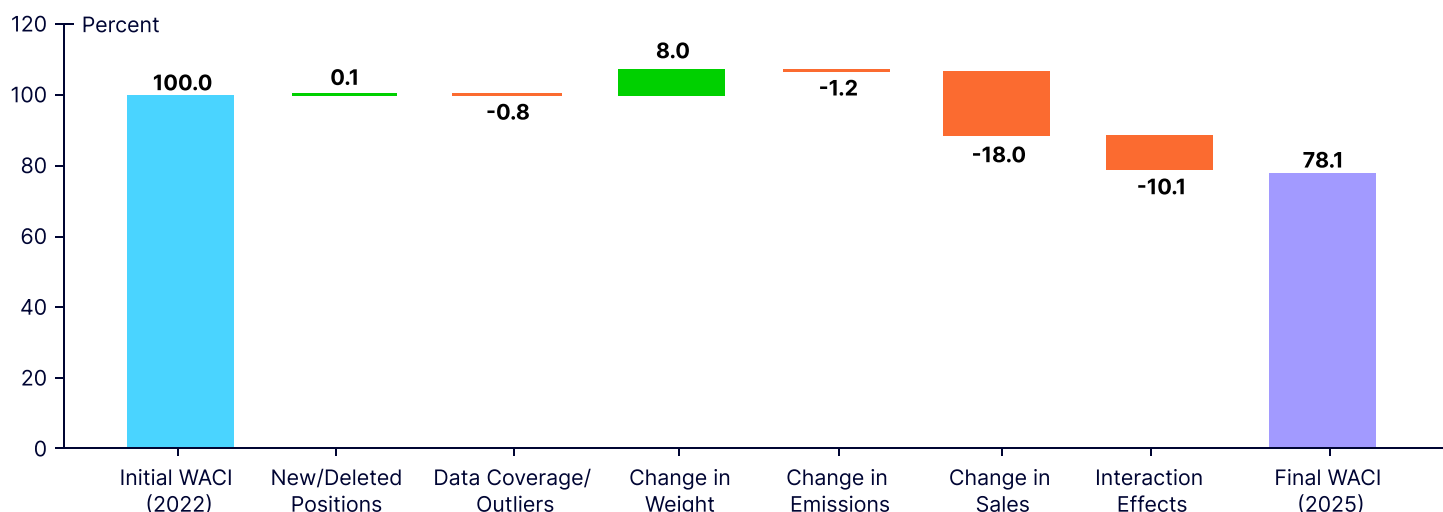


Source: State Street Investment Management, S&P, ISS. Data as at 8 June 2026.

The WACI of the S&P Emerging LargeMidCap Index declined by 28.8% between December 2022 and December 2025. Measuring each driver against the 2022 WACI (set at 100%), higher sales reduced the WACI by 25.4 percentage points, interaction effects

by 8.8 points, lower index weights by 4.2 points, new or deleted positions by 3.1 points, and changes in data coverage or outlier treatment by 2.4 points. These reductions were partly offset by higher carbon emissions, which added 15.1 points.

**Figure 7: WACI Drivers in Bloomberg Global Aggregate Corporate Bond Index<sup>13</sup>**  
Bloomberg Global Aggregate Corporate Bond Index—WACI Drivers (as a % of 2022 WACI)



Source: State Street Investment Management, Bloomberg, ISS. Data as at 8 June 2026.

As noted above, this framework can also be applied to the fixed income asset class. In Figure 7, we apply it to the Bloomberg Global Aggregate Corporate Bond Index.

The WACI of the Bloomberg Global Aggregate Corporate Bond Index declined by 21.9% between December 2022 and December 2025. Measuring each driver against the 2022 WACI (set at 100%), higher sales reduced the WACI by 18 percentage points, interaction effects by 10.1 points, and lower carbon emissions by 1.2 points. These reductions were partly offset by higher index weights, which added 8 points. Other drivers had a minimal effect.

## WACI Drivers in S&P Developed LargeMidCap Index: A Sectoral Analysis

We further breakdown the change in S&P Developed LargeMidCap Index's WACI to various GICS sectors, and apply the attribution framework per sector to provide additional insights. The breakdown method can also be applied on country or any other type of categorical classifications as long as there is sufficient data.

The table below shows sectoral contributions to the Index WACI at December 2022 and December 2025, as well as the sources of deviation at the sectoral level.

| Sector                 | Weight in Index (2025) (%) | Weight in Index (2022) (%) | Contribution to Index WACI (2025) | Contribution to Index WACI (2022) | Absolute Difference | % Change in Sectoral Contribution |
|------------------------|----------------------------|----------------------------|-----------------------------------|-----------------------------------|---------------------|-----------------------------------|
| Energy                 | 3.2                        | 5.5                        | 14.2                              | 39.7                              | -25.5               | -64.2                             |
| Materials              | 3.1                        | 4.4                        | 18.0                              | 31.5                              | -13.5               | -42.8                             |
| Industrials            | 11.1                       | 11.3                       | 8.1                               | 14.7                              | -6.5                | -44.6                             |
| Consumer Discretionary | 10.0                       | 9.6                        | 2.8                               | 3.7                               | -0.9                | -24.6                             |
| Consumer Staples       | 5.2                        | 8.2                        | 1.4                               | 3.6                               | -2.2                | -60.7                             |
| Health Care            | 9.4                        | 14.5                       | 1.1                               | 2.5                               | -1.4                | -57.3                             |
| Financials             | 17.1                       | 16.2                       | 2.5                               | 3.8                               | -1.4                | -36.1                             |
| Information Technology | 27.9                       | 18.3                       | 4.5                               | 3.8                               | 0.7                 | 18.7                              |
| Communication Services | 8.8                        | 6.2                        | 0.8                               | 0.9                               | 0.0                 | -4.4                              |
| Utilities              | 2.4                        | 3.2                        | 31.8                              | 57.0                              | -25.2               | -44.2                             |
| Real Estate            | 1.7                        | 2.5                        | 0.8                               | 1.6                               | -0.8                | -48.6                             |
| <b>Total</b>           | <b>100.0</b>               | <b>100.0</b>               | <b>86.0</b>                       | <b>162.6</b>                      | <b>-76.6</b>        |                                   |

Source: State Street Investment Management, S&P, ISS. Data as at 8 June 2026. Figures are rounded and may not add to totals.

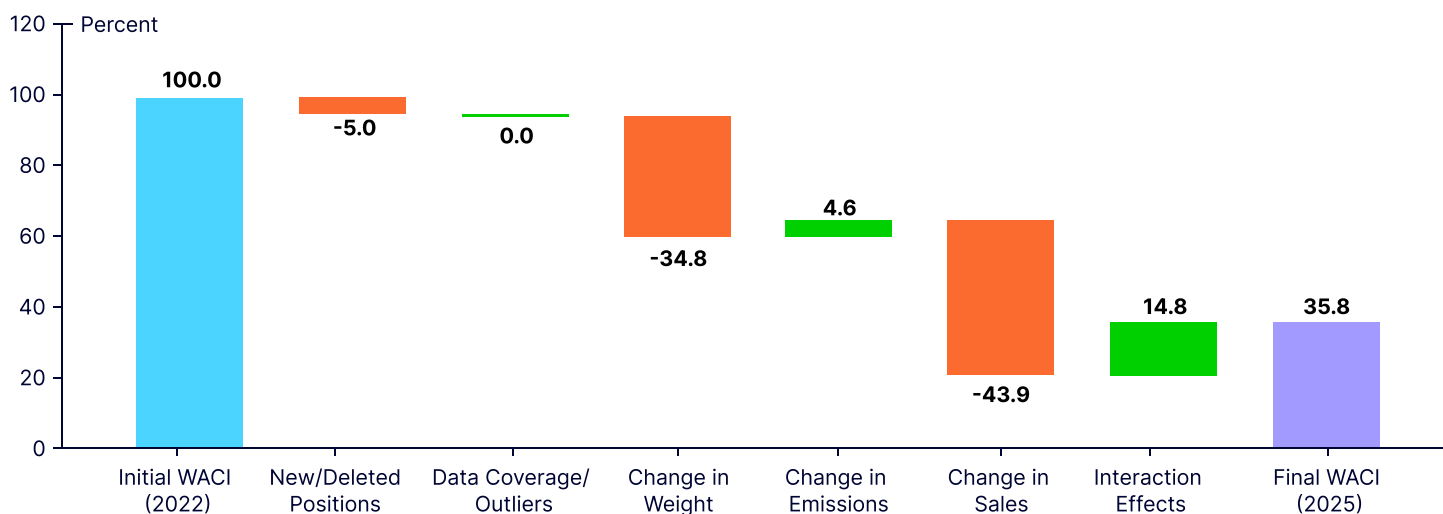
At a high level, we can see that the Utilities, Energy and Materials sectors contribute the most to the index WACI, as well as to the change in index WACI from 2022 to 2025. We now break these contributions further using the simplified attribution framework as described above.

For sectoral analysis, separate terms are added to account for carbon intensity changes caused by total sector weights allocations as well as those securities that have seen a change in their sector classification at the first layer of attribution. For the waterfall charts in Figures 8,9, and 10, these two terms are absorbed into the "Change in Weight" term for simplicity.

## WACI Drivers—Selected S&P Developed LargeMidCap Index Sectors

**Figure 8: WACI Drivers in S&P Developed LargeMidCap Index: Energy Sector**

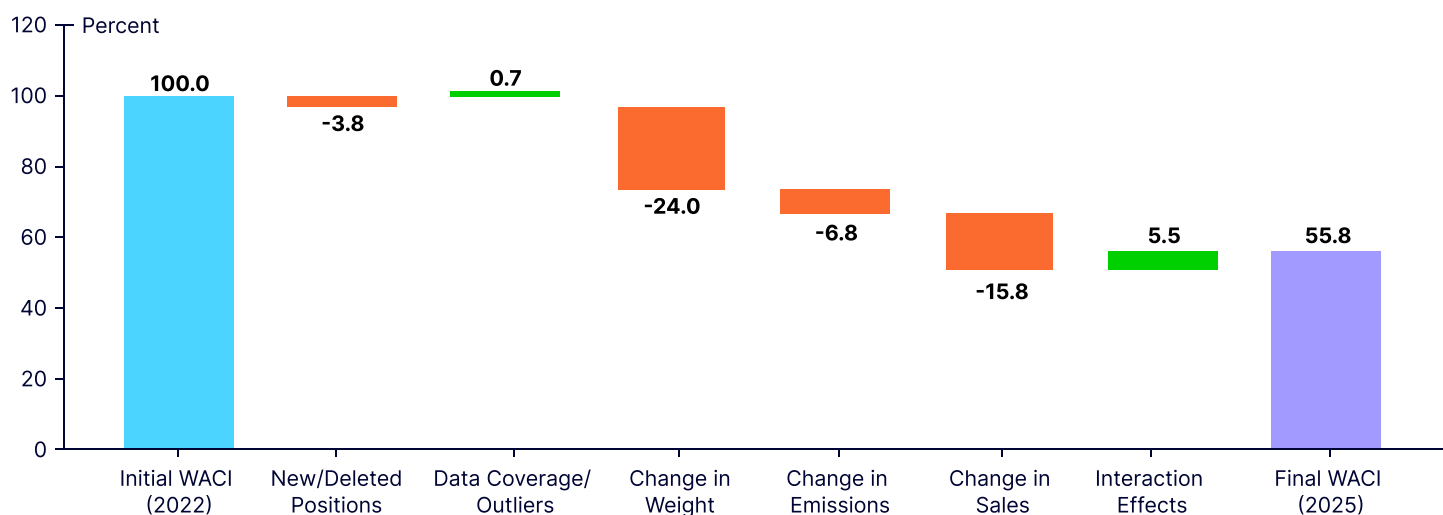
WACI Drivers—S&P Developed LargeMidCap Index Energy (as a % of 2022 Contribution)



Source: State Street Investment Management, S&P, ISS. Data as at 8 June 2026.

**Figure 9: WACI Drivers in S&P Developed LargeMidCap Index: Utilities Sector**

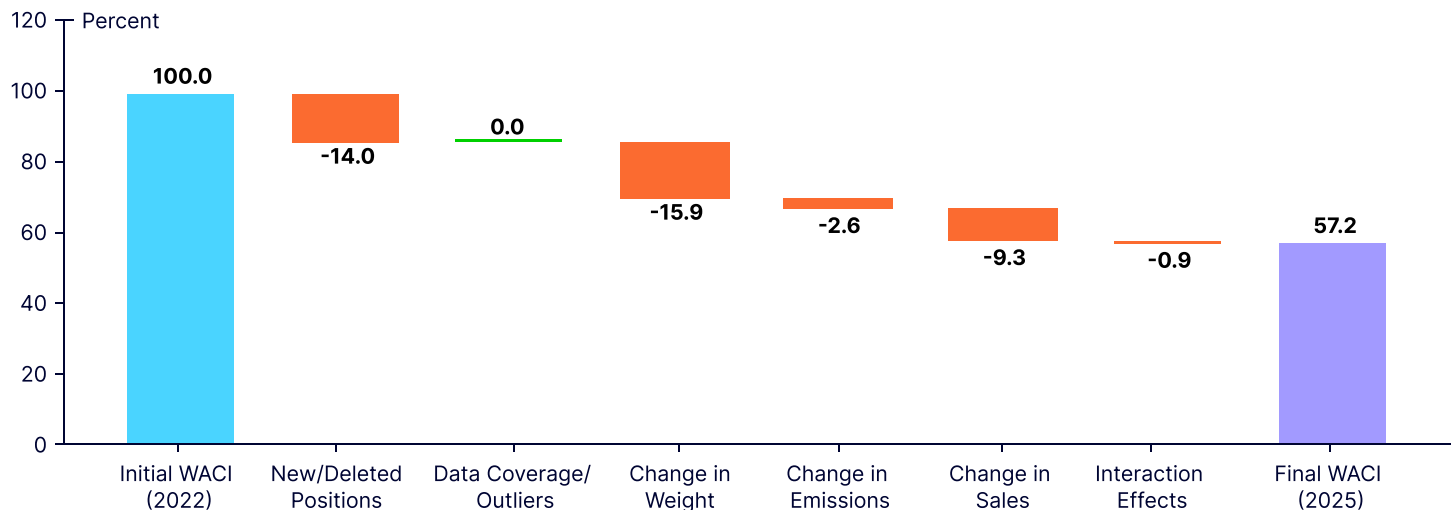
WACI Drivers—S&P Developed LargeMidCap Index Utilities (as a % of 2022 Contribution)



Source: State Street Investment Management, S&P, ISS. Data as at 8 June 2026.

**Figure 10: WACI Drivers in S&P Developed LargeMidCap Index: Materials Sector**

WACI Drivers—S&P Developed LargeMidCap Index Materials (as a % of 2022 Contribution)



Source: State Street Investment Management, S&P, ISS. Data as at 8 June 2026.

The Energy sector exhibits the highest WACI reductions in the last three years, followed by the Utilities sector and the Materials sector. Looking into the attribution factors, the interpretation of these sectoral charts is very similar to that of the index-level in the previous section. Some key observations:

- Relative to the index, New/Deleted Positions appear to be a more significant driver of WACI changes, particularly in Materials.
- Similarly, the Change in Weight also is a bigger driver since it considers the total sector weight allocations.
- For Utilities and Materials sectors, Change in Company Emissions has a downward effect on WACI contribution, while this is reversed for the Energy sectors. In other words, companies' emissions in the Utilities/Materials sectors reduced in aggregate, while those in Energy increased in total.
- Across all sectors, the Change in Sales term (i.e., an increase in sales) has a notable downward effect on WACI contribution, particularly in Energy.

## Conclusion

This analysis highlights the multifaceted nature of changes in Weighted Average Carbon Intensity (WACI) across major equity and fixed income indexes. While headline reductions in WACI may suggest that index constituents have decarbonized, our application of the carbon attribution framework suggests that these changes are often driven more by financial metrics (i.e., increase in sales) than by actual reductions in emissions. Sectoral analysis further dissects the drivers within some carbon-intensive sectors, and how they may differ to the overall index WACI. We note that this framework can be flexibly applied to different types of portfolios as long as data is available and can be a useful tool for investors seeking a more nuanced understanding of the underlying drivers of changes in portfolio emissions metrics.

## Endnotes

- 1 UN-convened Net-Zero Asset Owner Alliance, [2025 Progress Report](#).
- 2 Paris Aligned Asset Owners, [Signatory Disclosures](#).
- 3 UN-convened Net-Zero Asset Owner Alliance, [Understanding the Drivers of Investment Portfolio Decarbonisation](#).
- 4 Nagy, Zoltán, Guido Giese, and Xinxin Wang. "A Framework for Attributing Changes in Portfolio Carbon Footprint." *The Journal of Portfolio Management* 49.8 (2023): 163–184.
- 5 Note that while index holdings are sampled in December 2022 and December 2025, emissions data for most securities are of the financial year 2021 and 2024 respectively due to lags in corporate emissions reporting.
- 6 Land Use Change and Forestry.
- 7 Note that these years align closely with the emissions data being considered for the index WACI calculations as emissions data for most securities are of the financial year 2021 and 2024 respectively due to lags in corporate emissions reporting.
- 8 We use WACI as defined by the Task Force on Climate-related Financial Disclosures (TCFD). See [Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures](#), TCFD, 2021, p. 52. The units are tonnes of CO<sub>2</sub>-equivalent per \$ million revenue.
- 9 UN-convened Net-Zero Asset Owner Alliance, [Understanding the Drivers of Investment Portfolio Decarbonisation](#).
- 10 Nagy, Zoltán, Guido Giese, and Xinxin Wang. "A Framework for Attributing Changes in Portfolio Carbon Footprint." *The Journal of Portfolio Management* 49.8 (2023): 163–184.
- 11 Our analysis found the presence of some outliers which while having a small contribution to the overall WACI, had an outsized effect on the interaction terms in the second and third layers of the framework. As a result, we separate out these outliers in the first layer. Outliers are defined as securities which have less than 0.1% index weight and satisfy one of two conditions: (i) revenues increased over 50x and carbon intensity change less than 10x; or (ii) revenues decreased over 90% and carbon intensity change less than 10x.
- 12 Double counting effects in company emissions statistics commonly show up when aggregating different scopes of emissions (1, 2 and/or 3) at the portfolio level.
- 13 Note that for analysis of the bond universe, we use aggregated issuer level data rather than individual securities due to high security-level turnover in bond universes.

# About State Street Investment Management

At State Street Investment Management, we have been helping create better outcomes for institutions, financial intermediaries, and investors for nearly half a century. Starting with our early innovations in indexing and ETFs, our rigorous approach continues to be driven by market-tested expertise and a relentless commitment to those we serve. With over \$6 trillion in assets managed\*, clients in 60 countries, and a global network of strategic partners, we use our scale to deliver a comprehensive and cost-effective suite of investment solutions that help investors get wherever they want to go.

\* This figure is presented as of June 30, 2026 and includes ETF AUM of \$2,203.98 billion USD of which approximately \$156.81 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 Investment Management are affiliated. Please note all AUM is unaudited.

## statestreet.com/investment-management

State Street Global Advisors (SSGA) is now State Street Investment Management. Please click [here](#) for more information.

**For institutional/professional investors use only.**

### Marketing communication

### State Street Investment Management Worldwide Entities

### Important Information

The returns on a portfolio of securities which exclude companies that do not meet the portfolio's sustainable strategy criteria may trail the returns on a portfolio of securities which include such companies. A portfolio's sustainable strategy criteria may result in the portfolio investing in industry sectors or securities which underperform the market as a whole.

The information provided does not constitute investment advice and it should not be relied on as such. It should not be considered a solicitation to buy or an offer to sell a security. It does not take into account any investor's particular investment objectives, strategies, tax status or investment horizon. You should consult your tax and financial advisor.

The information contained in this communication is not a research recommendation or 'investment research' and is classified as a 'Marketing Communication' in accordance with the applicable regional regulation. This means that this marketing communication (a) has not been prepared in accordance with legal requirements designed to promote the independence of investment research (b) is not subject to any prohibition on dealing ahead of the dissemination of investment research.

This communication is directed at professional clients (this includes eligible counterparties as defined by the appropriate EU regulator who are deemed both knowledgeable and experienced in matters relating to investments. The products and services to which this communication relates are only available to such persons and persons of any other description (including retail clients) should not rely on this communication.

Investing involves risk including the risk of loss of principal.

The whole or any part of this work may not be reproduced, copied or transmitted or any of its contents disclosed to third parties without State Street Investment Management's express written consent.

All information is from State Street Investment Management unless otherwise noted

and has been obtained from sources believed to be reliable, but its accuracy is not guaranteed. There is no representation or warranty as to the current accuracy, reliability or completeness of, nor liability for, decisions based on such information and it should not be relied on as such.

The information contained above is for illustrative purposes only.

This document may contain certain statements deemed to be forward-looking statements. All statements, other than historical facts, contained within this document that address activities, events or developments that State Street Investment Management expects, believes or anticipates will or may occur in the future are forward-looking statements. These statements are based on certain assumptions and analyses made by State Street Investment Management in light of its experience and perception of historical trends, current conditions, expected future developments and other factors it believes are appropriate in the circumstances, many of which are detailed herein. Such statements are subject to a number of assumptions, risks, uncertainties, many of which are beyond State Street Investment Management's control. Please note that any such statements are not guarantees of any future performance and that actual results or developments may differ materially from those projected in the forward-looking statements.

The trademarks and service marks referenced herein are the property of their respective owners. Third party data providers make no warranties or representations of any kind relating to the accuracy, completeness or timeliness of the data and have no liability for damages of any kind relating to the use of such data.

Investing in foreign domiciled securities may involve risk of capital loss from unfavorable fluctuation in currency values, withholding taxes, from differences in generally accepted accounting principles or from economic or political instability in other nations.

Equity securities may fluctuate in value and can decline significantly in response to the activities of individual companies and general market and economic conditions.

Bonds generally present less short-term risk and volatility than stocks, but contain interest rate risk (as interest rates rise, bond prices usually fall); issuer default risk; issuer credit risk; liquidity risk; and inflation risk. These effects are usually pronounced for longer-term securities. Any fixed income security sold or redeemed prior to maturity may be subject to a substantial gain or loss.

© 2026 State Street Corporation. All Rights Reserved.  
ID4764700-9069655.1.1.GBL.INST 0926 Exp. Date: 30/09/2027