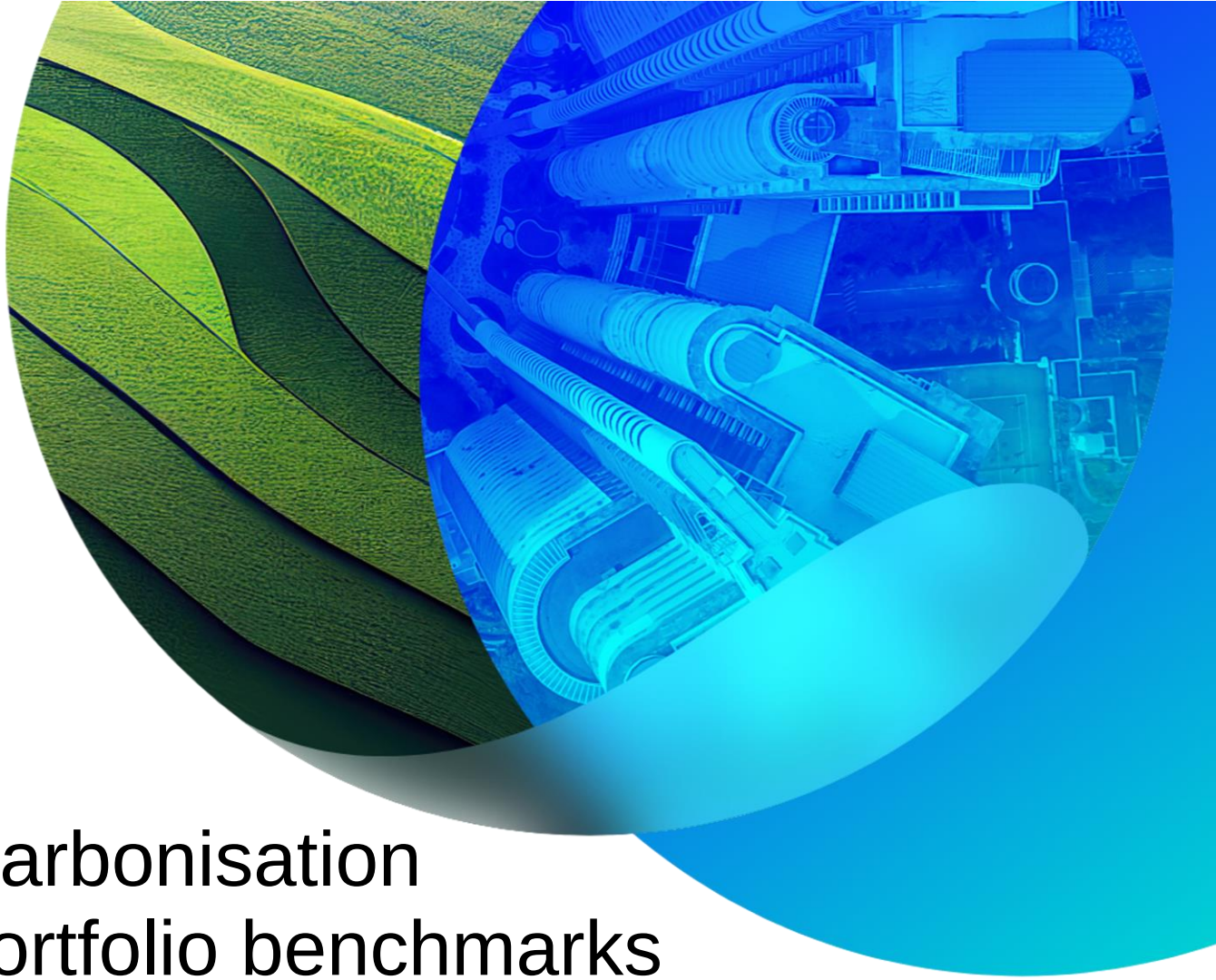

Decarbonisation in portfolio benchmarks

TRACKING PORTFOLIO CARBON TRANSITION

September 2024

Authors

Mobi Shemfe, PhD
Senior Research Lead, SFI
Mobi.Shemfe@lseg.com

Edmund Bourne
Research Lead, ESG
edmund.bourne@lseg.com

Alan Meng
Research Lead, Sustainable Fixed Income
Alan.Meng@lseg.com

Jack Simmons
Climate Strategy Lead, Benchmark & Indices
john.simmons@lseg.com

Felix Fouret
Research Lead, Climate and Transition
felix.fouret@lseg.com

Mallika Jain
Research Analyst, SFI
mallika.jain@lseg.com

Jaakko Kooroshy
Global Head, Sustainable Investment Research
jaakko.kooroshy@lseg.com

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Contents

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Foreword

This third edition of LSEG's Decarbonisation in Portfolio Benchmarks report - now expanded to include fixed income and further insights on Scope 3 emissions - represents a valuable contribution towards deepening our understanding of the decarbonisation of the real economy and its reflection in investment portfolios. The UN-Convened Net-Zero Asset Owner Alliance acknowledges and appreciates the valuable insights presented. As long-term investors, the members of the Alliance focus on understanding long-term trends.

The report underscores the critical importance of understanding the root cause of changes in emissions. By disaggregating these into their respective drivers and factors and by conducting analysis using a variety of methodologies, such as year-on-year versus long-term trends, it becomes possible to more accurately interpret emissions profiles and their respective changes.

It is encouraging to note the increasing number of new Scope 1 and 2 corporate reporters, particularly in emerging markets. At a benchmark level, 90% of the equity benchmark by index weight and 85% of the equivalent corporate fixed income universe now disclose their Scope 1 & 2. While Scope 3 disclosure remains more limited, it is gradually improving. Unfortunately, Scope 3 data is still relatively immature and using it for financial decision-making remains challenging.

Long-term trends show moderate annual increases in absolute emissions globally since 2016, reflecting real world developments. In contrast, relative intensity emissions have decreased during the same period, indicating a decoupling of emissions from economic growth. This would indicate that intermediate carbon intensity targets should be of a higher nominal value than absolute emission targets to account for economic growth.

Longer-term analysis has the advantage of smoothing year-on-year volatility and tends to yield more consistent results across different metrics. Thus, the methodology used is not critical for measuring long-term trends. By contrast, in applying an emissions attribution analysis, explaining the various drivers is pivotal in enabling a detailed interpretation of the emission trends.

The Alliance anticipates continued partnership and further in-depth analysis that will aid the Alliance and the wider community in advancing the decarbonisation efforts of the global economy. The Alliance is confident that this report will prove to be a crucial resource for investors who are tracking the evolution of their decarbonisation strategies.

Dr.Udo Riese, Head of Sustainable Investing at Allianz SE, Co-Lead Monitoring, Reporting and Verification Track

Jean-Francois Coppenolle, Sustainable Investment Director at Abeille Assurances, Co-Lead Monitoring, Reporting and Verification Track

Executive Summary

Portfolio emissions metrics – and the emissions' performance of key market benchmarks – are under close scrutiny as investors place growing emphasis on monitoring their carbon exposure. Such data is increasingly required for regulatory reporting, and helps to inform decisions on investment products, asset allocation and security selection. Importantly, some institutional investors – including members of the UN-convened Net-Zero Asset Owners Alliance (NZAOA), the Net-Zero Asset Managers Initiative (NZAM) and the Net Zero Banking Alliance (NZBA) – have set decarbonisation targets and use portfolio emissions data to set and track their commitments.

However, calculating portfolio emissions can be technically challenging, and resulting data is often hard to interpret. Investors must choose among multiple available metrics for measuring absolute emissions and carbon intensities, and there is still no strong consensus on the best way to evaluate portfolio carbon exposure. This makes it hard to consistently compare and communicate portfolio emissions results to market participants and other stakeholders.

Now in its third annual edition, this report – developed in collaboration with the NZAOA – tracks emissions trends in key market benchmarks across widely used absolute emissions and emissions intensity metrics. It also provides an attribution analysis to systematically explain the factors that drive the changes in these metrics.

In addition to our analysis of Scope 1 and 2 carbon exposures in equity markets (represented by the FTSE-All World index[1]), this year's report adds a more systematic analysis of Scope 3 portfolio emissions, and, for the first time, expands our work to fixed income, by including an analysis of emissions trends in global investment grade corporate bonds (represented by the FTSE WorldBIG Corp index[2]). We also explore newly proposed metrics, including I-PEP and duration-adjusted WACI for bond portfolios.

Key findings include:

- **Since the conclusion of the Paris Agreement, key financial benchmarks are decarbonising on an intensity basis (see p. 10).** Between 2016 and 2022, the weighted average carbon intensity of the FTSE All-World equity index has declined by 4.1% annually on a revenue basis (WACI) and 5.1% on an ownership basis (EVIC). Similar rates can be observed in fixed income, with the FTSE WorldBIG Corp index decarbonising at 3.9% (WACI) or 1.4% (EVIC) p.a. over the same time frame.
- **However, in absolute terms emissions – assessed in terms of chained absolute emissions (our preferred metric) – have continued to slowly increase for equities (by 2.3% pa) and have been largely flat for fixed income (- 0.7% pa) in the same time period (see p. 7).** While they add an important perspective, absolute emissions measures remain difficult to interpret in an investment context, as they are heavily influenced by the benchmark composition. Recent declines are for example explained by the exclusion of Russian equities from the FTSE All-World due to sanctions, while the greater inclusion of Chinese equities in 2019 resulted in large increases. Similarly, faster absolute decarbonisation in fixed income is mainly explained by investment-grade bond benchmarks skewing more towards developed markets.
- **Portfolio emissions performance can however be hard to track on a year-by-year basis because these long-term trends are often overshadowed by short-term fluctuations (see p. 10).** In 2022, the WACI intensity of the FTSE All-World increased by 3.8% year-on-year, while the EVIC intensity remained flat and the intensity by market capital fell by 6.9%.
- **Our attribution analysis (see p. 15) shows that this short-term volatility is driven by non-carbon factors – such as constituent churn, sector rotations or changes or adjustments to normalisation factors (for example EVIC, p. 18).** While their impact on individual metrics can diverge, they typically have much bigger influence than changes in company emissions disclosures. In the last year, changes in normalisation factors have contributed to a more than 10% change in top line carbon intensity (across multiple metrics), while changes in company reported emissions have contributed to a less than 1% reduction.
- **Investors should consider a dashboard of portfolio emissions metrics instead of any single measure.** As individual carbon metrics are regularly impacted by idiosyncratic biases and short-term volatility, their interpretation in isolation can be difficult or misleading (with the most used intensity metrics showing diverging trends: +4%, 0%, and -7% respectively between 2021 and 2022). We suggest viewing portfolio decarbonisation through a multi-variable lens, which allows for more nuanced consideration of decarbonisation, while focusing multiyear trends rather than year-on-year fluctuations.
- **The immaturity of Scope 3 data makes it challenging to consistently track value-chain emissions on a portfolio basis (see p. 22).** However, systematically disregarding company disclosures that omit the most material Scope 3 categories for their sector can reduce volatility by almost 50%, improve the stability and accuracy of Scope 3 data for portfolios and inform better estimates for non-disclosing companies.

[1] The FTSE All-World Index covers over 4,000 large and mid-cap companies from both developed and emerging markets, representing more than 90% of the global market capitalisation of listed equities.

[2] The FTSE World Broad Investment-Grade Corporate Bond Index (WorldBIG Corp) covers over 10,000 investment-grade corporate bonds issued by over 1,400 issuers spread across sectors and regions. It is a sub-index of the FTSE World Broad Investment-Grade Bond Index (WorldBIG®), and excludes government, government-sponsored/supranational, and collateralised bonds. With total par amount exceeding US$10 trillion, it provides a comprehensive representation of the global, investment-grade corporate bond universe. Available at:
https://research.ftserussell.com/Analytics/Factsheets/Home/DownloadSingleIssue?issueName=WBIG&IsManual=true

1. Introduction

As climate-related events are becoming more frequent and greenhouse gas (GHG) emissions remain persistently high, a growing number of investors are setting emissions reduction targets to align their portfolios with net-zero trajectories. To achieve these targets, investors are often adopting portfolio decarbonisation strategies aimed at reducing carbon portfolio exposures while preserving financial returns.

Though various methods have been proposed – for example by the International Sustainability Standards Board (ISSB) and Partnership for Carbon Accounting Financials (PCAF) – there is still no clear consensus on the best approach to monitor portfolio decarbonisation. In that context, some investor groups are advocating for a dashboard approach that incorporates a broader range of decarbonisation metrics[3] and emission attribution analysis. We provide a summary table to illustrate the range of available carbon exposure metrics in figure 1.

Consistent and comparable corporate emissions[4] data is critical to enabling investors to measure and monitor portfolio decarbonisation. Despite increasing levels of corporate disclosure, investors must still turn to estimates to fill missing values,[5] and even where corporate disclosed data is available comparability between firms continue to be challenging. This is particularly the case for Scope 3 emissions, where disclosures remain patchy and inconsistent.[6]

With investors and regulators alike looking to support quantitative emission reduction targets, this report seeks to help investors understand the trends and underpinning factors driving portfolio emissions metrics.

Two years after our first Decarbonisation in Equity Benchmarks report, we have updated our analysis of carbon exposures within global equity markets, as represented by the FTSE All-World Index in 2022, as well as expanding our research to consider corporate fixed income portfolios, using the FTSE World Broad Investment-Grade (WorldBIG) Corporate Bond Index as a representative benchmark.

This year's report examines trends in carbon exposures across these benchmarks through five lenses:

- Portfolio level absolute emissions (p.7)
- Trends in disclosures and company-level emissions (p.8)
- Portfolio level emissions intensities (p.10)
- Attribution analysis of changes to portfolio carbon intensity (p.17)
- Exploration of Scope 3 exposures within the FTSE All World Index, through the lens of our proprietary Scope 3 materiality filter (p.22)

[3] See for example IIGCC's paper 'Enhancing the Quality of Net Zero Benchmarks' and the Net Zero Asset Owner Alliance's 'Development and Uptake of Net-Zero-Aligned Benchmarks'.

[4] Corporate emissions include Scope 1, 2 and 3 emissions. Scope 1 and 2 are direct and indirect operational emissions, while Scope 3 encompass all emissions that occur outside the company's immediate control, but are associated with their value chain.

[5] LSEG, Mind the gaps: Clarifying Corporate Carbon | FTSE Russell Research (lseg.com)

[6] LSEG, Scope for Improvement -Solving the Scope 3 conundrum.

Figure 1: Overview of key carbon exposure metrics

	Description	Included in	Unit	Absolute or intensity	Emissions normalisation factor[7]	Complexities when applying to portfolio benchmarks
Aggregate emissions	Total emissions of all investee firms[8]		Tonnes	Absolute	None	– New constituents introduce volatility – Does not factor in portfolio weight – Can result in double counting of emissions
Chained Emissions	Total emissions of persistent constituents[9]		Tonnes	Absolute	None	– Does not factor in portfolio weight – Can result in double counting of emissions
Weighted Average Carbon Intensity (WACI)[10]	Average of carbon intensity (revenues) of investee firms, weighted by portfolio exposure	TCFD	Tonnes per USD revenue	Intensity	Annual revenues *i.e., WACI (revenue) in this paper*	– Significant revenue volatility for high-emitting sectors – Revenues differ in meaning across firms and sectors
Financed Emissions	Total emissions owned by portfolio through its investee firms	TCFD PCAF	Tonnes	Absolute	None	– Unnormalised outputs makes point-in-time cross-portfolio comparison difficult – Does not factor into carbon efficiency of individual firms
Carbon Intensity (Carbon Footprint)	Total emissions owned by portfolio through its investee firms, per USD invested	TCFD PCAF	Tonnes per USD invested	Intensity	Firm size measured by market cap *i.e., Carbon intensity (market cap) in this paper* Firm size measured by enterprise value *i.e., Carbon intensity (EVIC) in this paper*	– Significant volatility of underlying asset values, requiring inflation adjustment – Does not factor into carbon efficiency of individual firms' outputs
Physical intensity	Total Emissions divided by total physical production of firms	TCFD PCAF	Tonnes per unit output	Intensity	Production unit[11]	– Production units differ between sectors and commoditised outputs do not exist for most firms, making cross-sector applications difficult

[7] Intensity measures are generally derived by dividing emissions by a normalisation factor, which contextualises emissions against a firm's revenues, physical outputs, or overall size (e.g., by EVIC).

[8] In fixed income, an investee firm is the issuer of bonds. The weight of an investee firm in a portfolio equals to the total weight of all bonds issued by the firm that have been included in the portfolio.

[9] We calculate chained emissions as the change in absolute emissions each year for persistent constituents only – i.e., firms that were also in the index prior to a given year. See previous report: Decarbonisation in equity benchmarks (lseg.com)

[10] In their Handbook for the construction of Paris Aligned and Climate Transition Benchmarks, the Technical Expert Group of the EU Commission recommends a WACI with EVIC as a normalisation factor, in place of revenues. This – when implemented as part of an index, with (assumed) constant assets under management – is proportionally equivalent to an implementation of Carbon Footprint as listed above. See Handbook of climate transition benchmarks, Paris-aligned benchmark and benchmarks' ESG disclosures (europa.eu)

[11] Depending on the sector – production units can include barrels of oil equivalent of Oil and Gas, tonnes of Coal, Steel, Cement, or minerals, as well as other homogenized products

2. Carbon emissions of global portfolio benchmarks

2.1 ABSOLUTE EMISSIONS

Absolute emissions are conceptually the most straightforward way to consider a portfolio's carbon exposure,[12] assuming that each constituent's total emissions are fully attributable to the portfolio, regardless of their relative weight. This metric is often cited as the purest representation of real-world emissions change. Since the time of the Paris Agreement, aggregate emissions of All-World firms have increased by about 20%, a trend in the same direction as global emissions.[13]

However, absolute emissions are sensitive to other factors beyond physical real-world emissions – particularly changes in portfolio composition and emissions estimations for non-disclosing firms. For example, the recent 5% decline of absolute emissions between 2021 and 2022 (see figure 4) mostly reflects the removal of high emitting Russian constituents from the FTSE All-World index due to Ukraine-linked sanctions rather than decarbonisation occurring at the company level (see figure 39 in Appendix III).[14]

To account for these sensitivities, investors can use two alternative absolute emissions metrics which tend to be less volatile:

– **Chained emissions:** this metric considers absolute emissions of persistent index constituents, avoiding distortions from constituent churn.

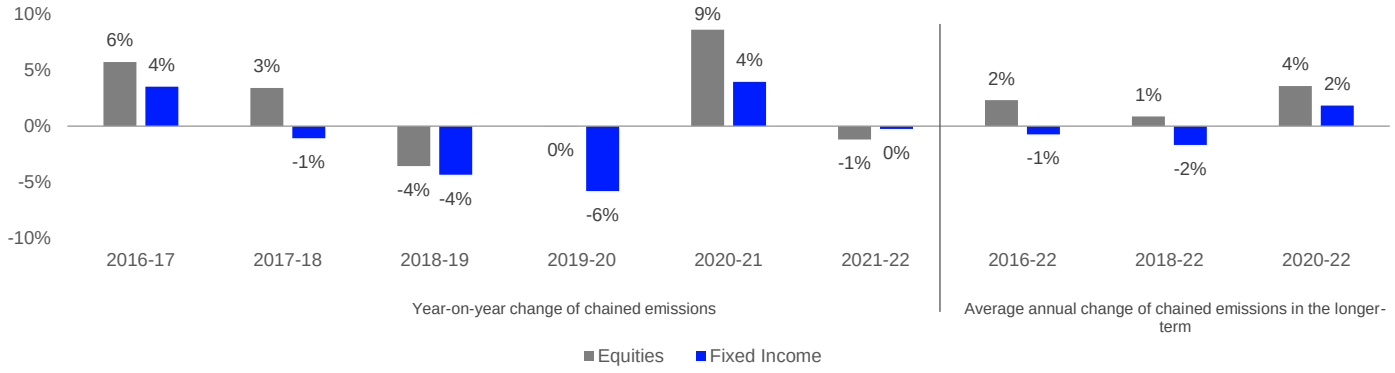
– **Chained disclosed emissions:** this metric further focuses on chained emissions by considering only firms which regularly disclose emissions, avoiding impacts from both constituent churn and changes in emissions estimations.

Using chained emissions, we find an average long-term (2016-22) annual absolute emissions growth rate of c.2% for equities, compared to -1% for fixed income (see figure 2). This is partly due to the FTSE WorldBIG Corp eligibility criteria, which lead to a higher concentration of developed market issuers, where the transition to net zero is often more advanced. Similar to equities, fixed income experienced the largest year-on-year absolute emissions decrease in 2020 (-8%) due to the impact of COVID19, followed by a swift rebound by 9% in 2021 (see figure 6).

Note that assessing absolute emissions at the portfolio level for the fixed income benchmark presents additional challenges due to the diverse types of bond issuers and debt instruments, as unlisted corporates are less likely to disclose their emissions.[15] To tackle this, we mapped private bond issuers to their 'nearest public parent issuer' (NPI)[16], but otherwise treat absolute emissions calculations in a similar manner to equities.

Figure 2: Long-term downward trend in chained emissions for fixed income, but few signs of decline in equities

Change in chained emissions in FTSE WorldBIG Corp and FTSE All-World



Source: LSEG, August 2024

[12] It is calculated by summing the total scope 1 and 2 emissions associated with companies within the index in a given year.

[13] 1. IMF Climate Change Indicators Dashboard Greenhouse Gas Emissions | Climate Change Indicators Dashboard (imf.org); 2.WRI World Resources Institute: Annual global GHG emissions of industries and households have increased c.5% since the time of the Paris agreement.

[14] LSEG, Treatment of Russia in FTSE Russell Equity Indices, March 2022

[15] While the high yield sector tends to have a higher carbon footprint compared to investment grade bonds due to its sector composition and industry focus, the carbon emission data coverage is much lower than that of investment grade bonds. With this consideration, this year's research has excluded the high yield universe.

[16] NPI is the nearest listed parent company on the corporate tree of a certain bond issuing entity. For example, private issuers that are owned by listed parent companies are assigned their parents' emissions if they are in the same industry or if the subsidiary is non-operating. More details about the NPI approach and how coverage increases by using NPI is discussed in our paper FTSE Russell | A Paris-Aligned Corporate Bond Benchmark

Figure 3: Long-term trends show little progress in absolute emissions

Absolute emissions, FTSE All-World Index (2015=100)

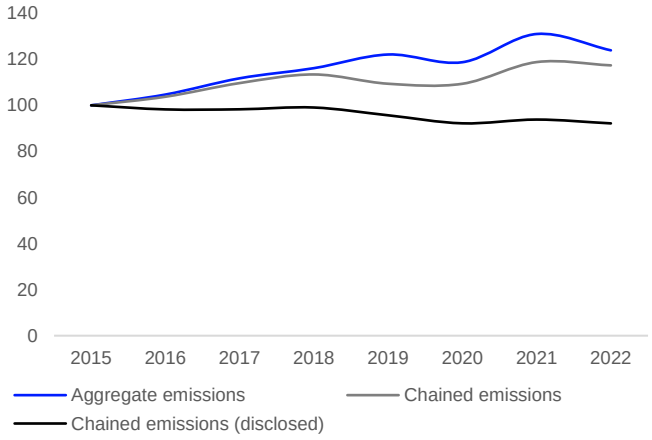
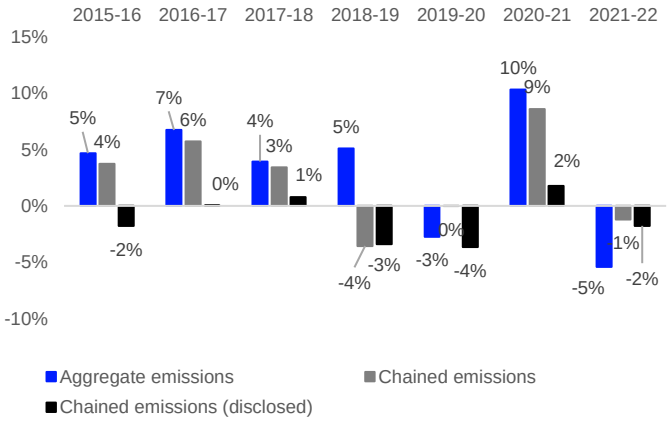


Figure 4: Though recent reading shows a marginal reduction across measures

Annual relative change in absolute emissions, FTSE All-World



Source: LSEG, August 2024

Figure 5: More consistent long-term declines in corporate fixed income

Absolute emissions, FTSE WorldBIG Corp (2016=100)

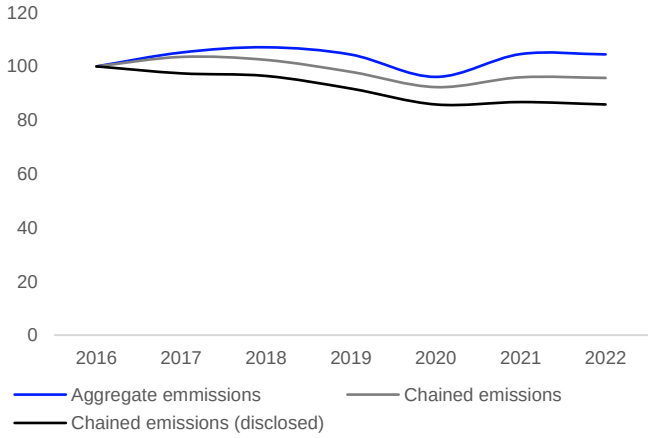
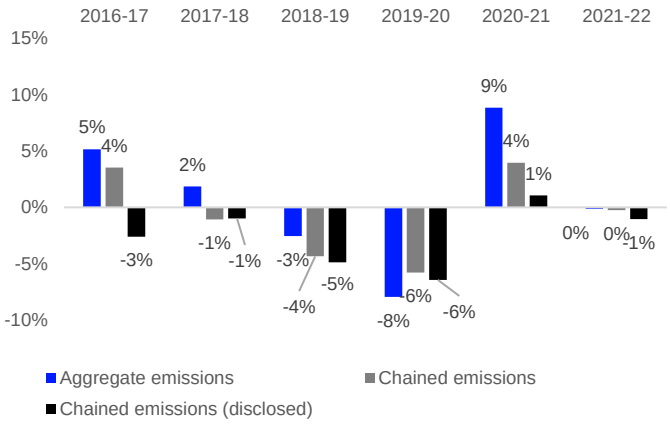


Figure 6: Marginal emissions decline post-Covid recovery

Annual relative change in absolute emissions, FTSE WorldBIG Corp



Source: LSEG, August 2024

2.2 TRENDS IN DISCLOSURES AND COMPANY-LEVEL EMISSIONS

Examining trends at constituent level can offer an additional perspective on the underlying factors influencing aggregate portfolio emissions trends. We focus our analysis on reported emissions which generally provide a more accurate representation of real-world changes in emissions.[17]

The median annual change in reported emissions for equities hit a low point of -5% between 2019 and 2020, driven by the COVID contraction, but has since stabilised at 0% from 2020 to 2022 (see figure 7).[18]There is a wide distribution of annual change in corporate emissions, with the upper and lower quartiles of disclosing listed equities showing a 10% increase and an 8% reduction, respectively (see figure 7). A comparison of carbon-intensive[19] sectors against other sectors in the equity universe shows slightly lower volatility in annual emissions within carbon-intensive sectors (see figure 42 in Appendix III). The fixed income benchmark shows a similar pattern, with median annual change stabilising just below zero in 2022 (see figure 8).

[17] This is not the case with Scope 3 emissions due to the relative immaturity and complexity of Scope 3 disclosures.

[18] Notably, despite a 5% decrease in emissions in 2020 during the Covid contraction (see figure 7), a rebound was not seen in the median change in either of the proceeding years.

[19] Carbon intensive sectors include, Utilities, Energy, Basic Materials and Industrials, per Industry Classification Benchmark (ICB) level 1 classification.

Figure 7: Emissions remain stable overall for equities

Annual change distribution in reported Scope 1 and 2 emissions, equities

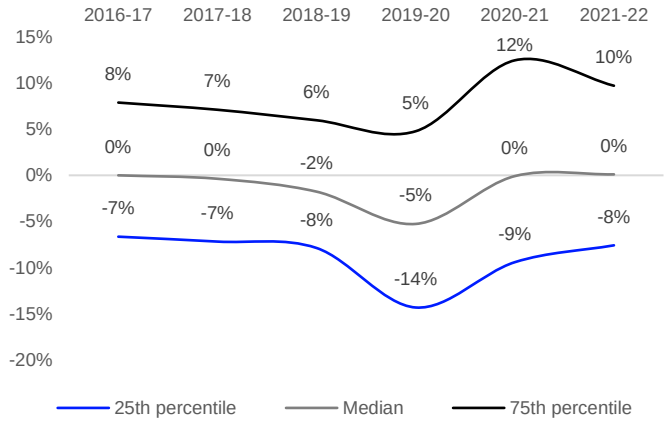
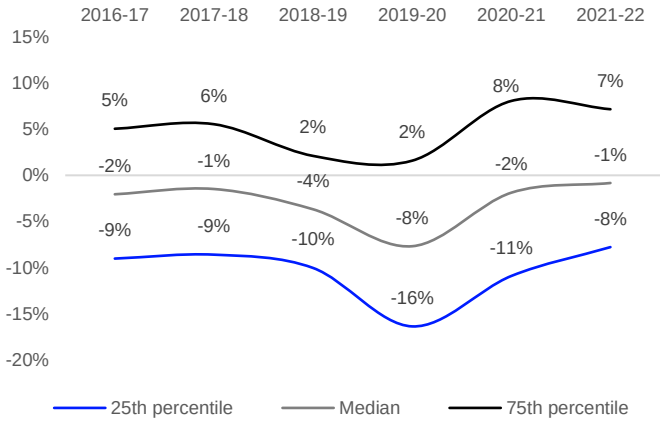


Figure 8: Emissions also stable for fixed income, but wider variations

Annual change distribution in reported Scope 1 and 2 emissions, fixed income



Source: LSEG, August 2024

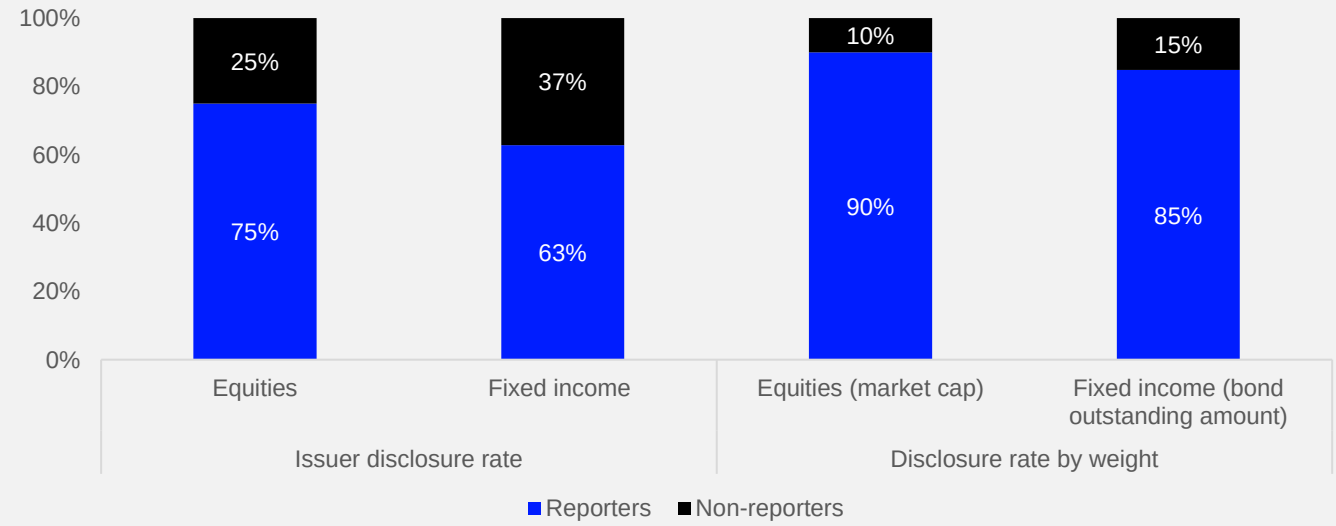
Box 1. Scopes 1 and 2 emissions disclosure continues to improve

When analysing portfolio emissions, it is important to differentiate between reported and estimated emissions data, as there remain significant challenges in accurately estimating carbon data.[20] Growing regulatory focus on emissions disclosures has contributed to improved disclosures. In 2022, the Scope 1 and 2 emissions disclosure rate in the FTSE All-World index was 75%, up from 58% in 2016, with about two thirds of companies now consistently[21] reporting emissions**.**

Similarly, the number of companies disclosing their Scope 1 and 2 emissions in the FTSE WorldBIG Corp index rose to 63% in 2022, up from around 56% in 2016. However, disclosure rates in fixed income still lag equities. In terms of index weight, 85% of bonds by notional outstanding have reported their emissions, compared to 90% of equities by market capitalisation (see figure 9). Increases in company disclosure levels are particularly noticeable in Emerging markets, growing to 61% (equities) and 50% (fixed income) in 2022 from 45% and 25% in 2016, respectively.

Figure 9: Fixed income lags despite growing emissions disclosures in both benchmarks

Scope 1 and 2 emissions disclosure in equities and fixed income benchmarks, 2022



Source: LSEG, August 2024

[20]See more details in our report: Mind the gaps: clarifying corporate carbon.

[21] Companies that disclose emissions each year and the previous year.

2.3 EMISSIONS INTENSITY

Emissions intensities are often preferred by investors for tracking and reporting portfolio emissions, as they are more comparable over time and across portfolios of different sizes, in particular taking into account relative security weights. These intensities are calculated by normalising absolute emissions relative to a measure of the size of a firm (i.e., revenues, EVIC, or market capitalisation), before aggregating to the portfolio level.

The choice of normalisation factor is critical (see Appendix II for commonly used normalisation factors).[22] When normalised by a measure of economic output, such as annual revenues, carbon intensity provides a view of how efficiently a company operates in terms of the carbon it emits. In contrast, carbon intensity normalised by company value, such as EVIC or market capitalisation, when adjusted by portfolio weight offers a different view, acting as a measure of the portion of a company's emissions that an investor finances.[23]

In this year's report, we update our analysis of inflation-adjusted carbon intensities in the FTSE All-World index, focusing on weighted average carbon intensity (WACI) by revenues and carbon intensities by company and market value, normalised through EVIC and market capitalisation, respectively. We also add similar intensity calculations for the fixed income benchmark, omitting carbon intensity by market capitalisation[24] which cannot be calculated for bond portfolios with private issuers (i.e. those companies without market based values of equity).

In the equity benchmark, WACI, carbon intensity by EVIC and by market capitalisation saw declines of 13%, 22%, and 29% between 2016 and 2022. However, 2022 saw a divergence: WACI increased by 4%, while carbon intensity by market capitalisation fell 7%, and carbon intensity by EVIC remained flat (see figure 11), reversing a consistent decline since 2018. For the fixed income benchmark, WACI and carbon intensity by EVIC decreased by 21% and 8.5% respectively from 2016 to 2022, though both metrics have drawn closer following a rapid decrease in carbon intensity by EVIC in 2022 (see figure 12).

Figure 10: Carbon intensity, equities, three ways

Scope 1 and 2 intensity, FTSE All-World (2015=100)

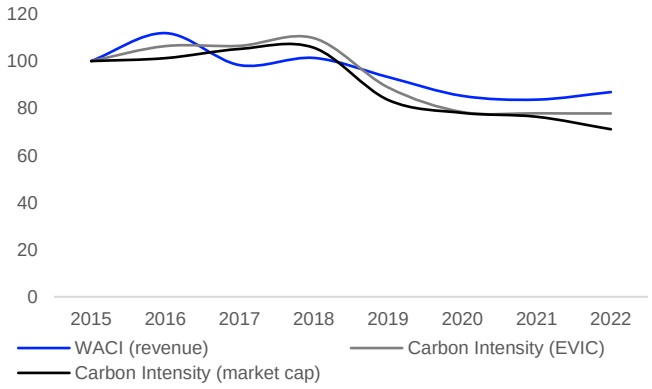
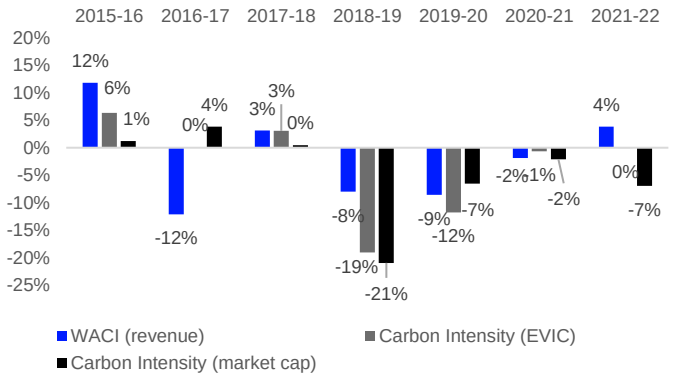


Figure 11: Mixed picture across index intensity metrics

Annual change in index carbon intensity, FTSE All-World



Source: LSEG, August 2024

Figure 12: Carbon intensity, fixed income, two ways

Scope 1 and 2 intensity, FTSE WorldBIG Corp (2016=100)

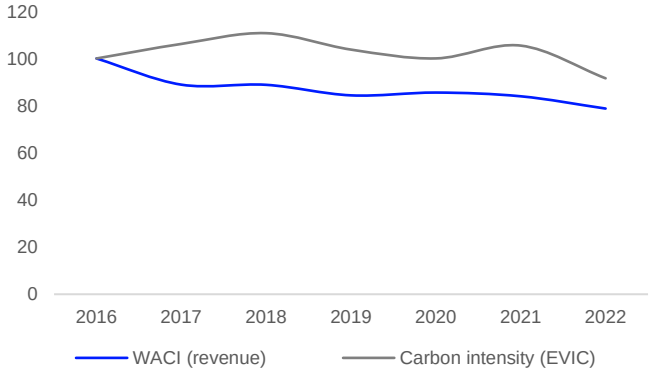
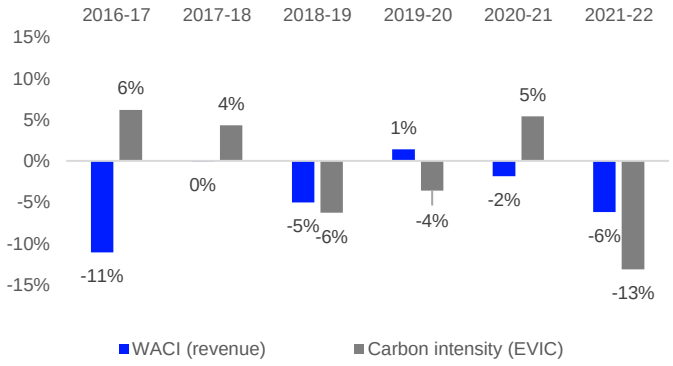


Figure 13: 2022 experienced the largest YoY decease

Annual change in index carbon intensity, FTSE WorldBIG Corp



Source: LSEG, August 2024

[22] We have previously written about the nuances of intensity normalisation methods. See Decarbonisation in equity benchmarks (lseg.com), p. 12.

[23] i.e., the value invested relative to total firm value acts as a proxy for the percentage of firm emissions attributable to the investor.

[24] i.e., market value of equity.

Though changes in intensity metrics often diverge significantly on a year-on-year basis, on a longer-term basis they tend to be more consistent. Between 2016 and 2022, all three metrics for equities declined by more than 4% p.a. on average (see figure 14). Carbon intensity metrics by EVIC and market cap have seen more dramatic declines of 8% and 9% between 2018 and 2022, while WACI declines have been more moderate (c. 4%).

Differing rates of decarbonisation across intensity metrics is driven by variations in underlying normalisation factors. Between 2016 and 2022, WACI, carbon intensity by EVIC and market capitalisation in the equities saw average annual emissions reduction rates of c.4%, c.5% and c.6% (see figure 14). This divergence was partially driven by faster growth in EVIC and market capitalisation annually relative to revenues, though this trend reversed between 2021 and 2022 (see figure 43 in Appendix III). In contrast, the fixed income benchmark saw a more moderate long-term annual emission reduction rate in carbon intensity by EVIC (c.1%), as it is less correlated with rising market valuations, though its WACI closely mirrors that of equities (see figure 15).

Figure 14: Faster intensity reductions in equities due to more volatile normalisation factors

Compound annual change rate in carbon intensity, equities

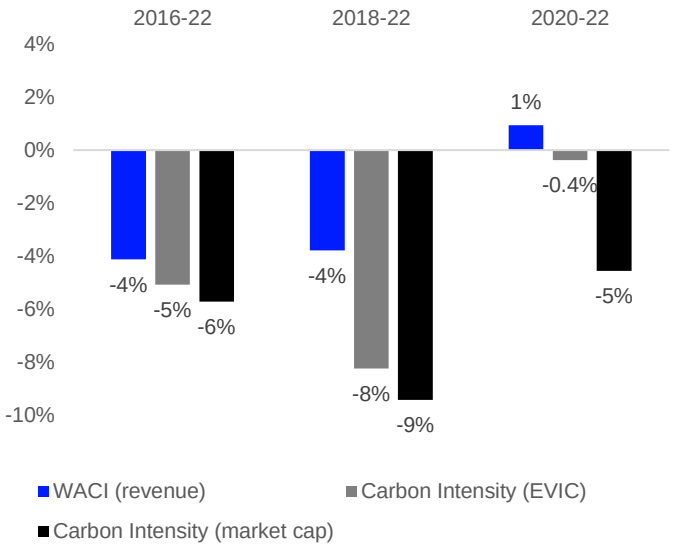
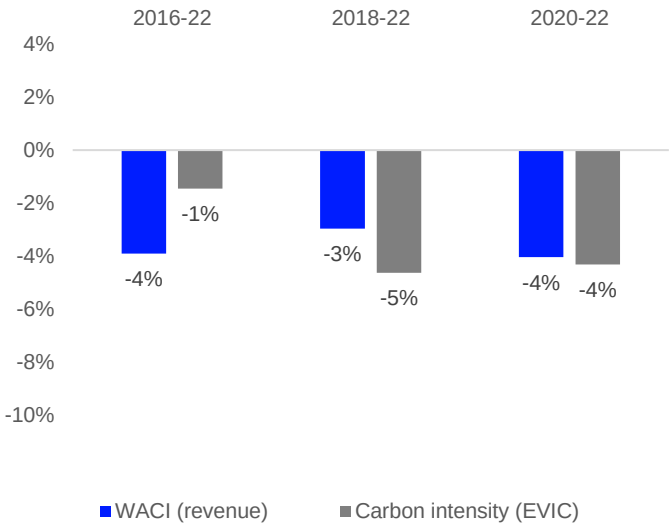


Figure 15: WACI reductions on par with equities but slower for EVIC intensity

Compound annual change rate in carbon intensity, fixed income



Source: LSEG, August 2024

Box 2. Effect of EVIC inflation adjustment on fixed income carbon intensity

The EVIC inflation adjustment approach provided under the EU regulation for Paris-Aligned and Climate Transition benchmarks considers annual changes in the average EVIC of constituents. This approach can influence the trajectory of portfolio intensity. In particular, an increase in constituents' EVIC can result in a reduction in portfolio intensity even when no reduction in carbon emissions has occurred. Moreover, the regulation does not differentiate between equity and fixed income benchmarks in its methodology. To tackle these challenges, the EU Platform for Sustainable Finance has recently proposed a revised EVIC adjustment approach at the security level.[25]

Against this backdrop, we have conducted an initial assessment of the implications of different inflation adjustment approaches on portfolio EVIC carbon intensity, illustrated below with the fixed income benchmark (see figure 16).[26] In addition to the regulation's approach, we analyse an alternative adjustment factor based on consistent constituents only.[27] This approach helps to mitigate distortions caused by issuers entering or exiting the fixed income index. The findings indicate:

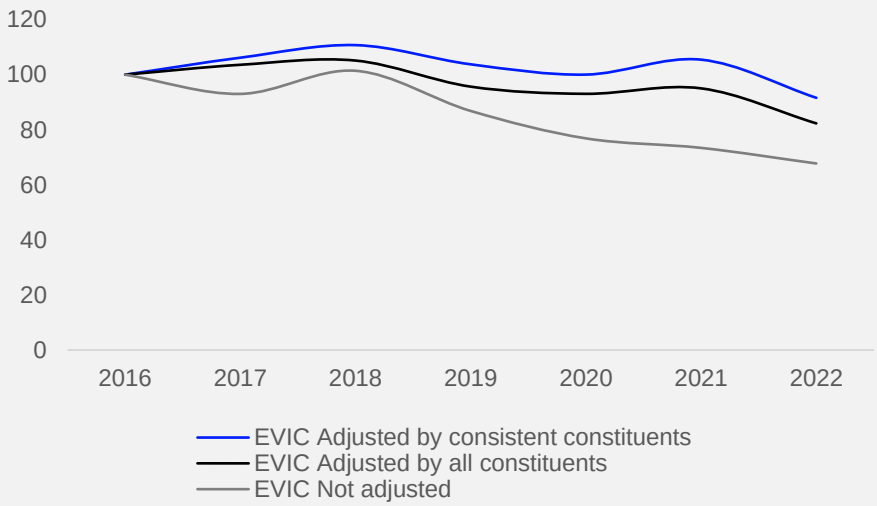
– Without any EVIC inflation adjustment, we observe the steepest decline in portfolio carbon intensity, due to growth of EVIC over time, overstating reductions in intensity (see grey line in figure 16).

– Adjusting EVIC using the average of all constituents results in a more rapid decline (black line) in carbon intensity compared to adjusting EVIC based only on consistent constituents (blue line).

– This could be attributed to the inclusion of inaugural bond issuers, whose smaller EVIC values tend to drag down the average, amplifying adjusted emission intensity.[28] Focusing on seasoned issuers with more stable financial performance through consistent bonds makes the adjustment factor calculation more continuous and representative.

Figure 16: Different EVIC adjustment approaches have different implications on fixed income emission intensity reduction

FTSE WorldBIG Corp (2016=100)



Source: LSEG, August 2024

[25] EU Platform on Sustainable Finance. (2022) Platform Recommendations on Data and Usability. Available at: Platform on Sustainable Finance's recommendations on data and usability of the EU taxonomy (europa.eu) (Accessed: 21 August 2024)

[26] See figures 47 and 48 in Appendix III, comparing carbon intensity by EVIC and Market Cap with and without inflation adjustment for the equity benchmark

[27] By comparing the average EVIC of issuers in a certain year with that of the same issuers in the base year.

[28] A smaller average EVIC in a certain year leads to less adjustment to historical EVIC comparing to focusing on consistent constituents. This will result higher carbon intensity values at historical times (as carbon intensity is calculated by dividing emissions by adjusted EVIC) – displaying a more rapid reduction.

2.4 EXPLORING NOVEL INTENSITY MEASURES

I-PEP

Indicators for Portfolio-weighted Emissions Performances (I-PEP) are a new set of metrics recently proposed by the Austrian Green Finance Alliance.[29] These metrics are designed as a measure of change in portfolio intensity and seek to avoid the impact and complexities of normalising intensity by financial metrics (e.g., EVIC, market capitalisation or revenues).

I-PEPs core principle is to measure the change in a company's absolute GHG emissions year-on-year[30] ('emissions performance') and then weight this according to a company's portfolio weight (or by a combination of portfolio weight and relative proportion of emissions). [31] This is then summed across all companies to calculate an 'aggregate portfolio-weighted emissions performance' as a percentage.

Figure 17: I-PEP methodology for corporates

i-PEP methodology for corporates	*Emissions performance*	$\rho_A = \frac{E_{A,t+1}}{E_{A,t}}$-1	E_A= *Absolute GHG emissions for Company A* ρ_A= *Emission performance of Company A*
	Portfolio weight	$w_A = \frac{V_A}{V_P}$	V_A= *Value of investment in Company A* V_P= *total value of portfolio investment*

Source: LSEG adapted from Green Finance Alliance

We believe I-PEP is best interpreted as a measure of emissions momentum. It can offer useful additional insights on portfolio emissions, as year-on-year changes in a corporate's own emissions in some cases are more indicative of performance than relative carbon intensity against sector peers. It also has certain other advantages, as it avoids the volatility associated with financial normalisation factors and the complexities in their annual adjustment.

However, I-PEP should not be considered as an appropriate replacement to conventional intensity metrics. Deemphasizing absolute level of emissions in favour of a weighted aggregation of relative change (as in I-PEP) can make it difficult for investors to gauge decarbonisation progress for a portfolio over multiple years and does not eliminate idiosyncratic volatility and distortions. Further, momentum metrics need to be carefully calibrated to consider only high-quality carbon disclosures, in order to limit the impact from changes in estimated emissions.

Duration perspective in fixed income

While equities are generally perpetual securities, bonds normally have a maturity date.[32] Therefore, the length of an investment (and hence the financing of) a GHG emitting entity or activity should be considered when calculating fixed income carbon footprint.[33] By decomposing the attributed emissions into a time component, bonds of different tenors from the same issuing entity are attributed at different levels.

We have used the Macaulay Duration - the weighted average time to maturity of a bond (i.e., weighted average of time to receipt of coupon interest and principal payments) [34] to produce a Duration-adjusted Weighted Average Carbon Intensity (or Duration-adjusted WACI). We found the Duration-adjusted WACI is consistently higher than the conventional WACI [35] (see figure 18), suggesting a fixed income portfolio could be more carbon-intensive if the duration perspective of bonds is considered. This finding also echoes

[29] Federal Ministry Republic of Austria for Climate Action, Environment, Energy, Mobility, Innovation and Technology, Consultation (bmk.gv.at)

[30] Metrics based on the same principles are proposed across other asset classes (e.g. sovereigns, project finance, mortgages)

[31] 'I-PEPs extended' metrics take these principles further, proposing a methodology to weight a company's contribution to portfolio level emissions by a combination of relative weight and emissions level compared to total (i.e. % total emissions, % total investment), with the contribution of these factors set by the user.

[32] Exceptions include perpetual bonds which do not have a maturity date, and other types of bonds such as convertible bonds which can be converted into equities.

[33] E.H.Brote. (2020) Duration-Weighted Carbon Footprint Metrics and Carbon Risk Factor for Credit Portfolios. Available at:https://www.diva-portal.org/smash/get/diva2:1431618/FULLTEXT02.pdf (Accessed 05 August 2024)

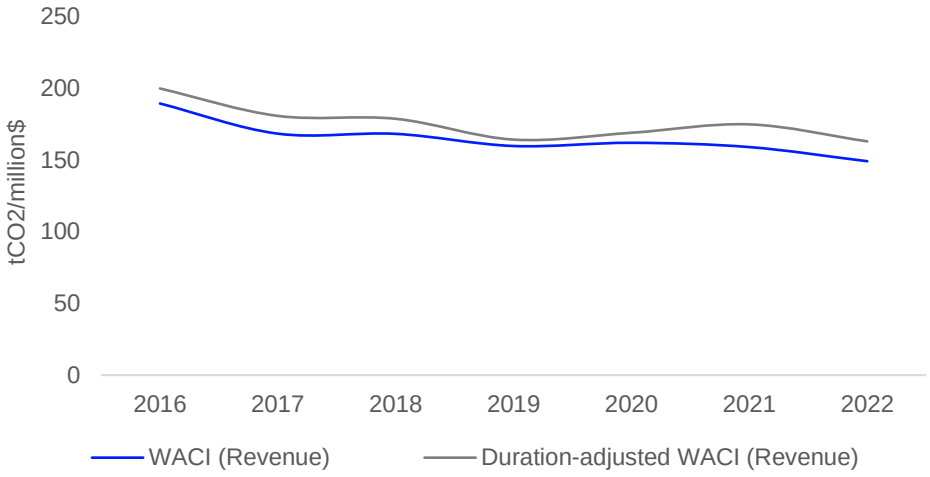
[34] CFA. (2023) Understanding Fixed-Income Risk and Return. Available at: https://www.cfainstitute.org/en/membership/professional-development/refresher-readings/understanding-fixed-income-risk-return. (Accessed: 11 August 2024)

[35] The conventional WACI is weighted by the book value of bonds, i.e an issuer's weight in the index in a given year equals to the sum of weights of all bonds issued by the same issuer.

our previous research, which indicates that carbon-intensive bonds tend to be larger in size and have a longer tenor compared to corporate bonds in other sectors.[36]

Figure 18: Fixed income portfolio is more carbon intensive with duration added into consideration

WACI vs duration-adjusted WACI



Source: LSEG, August 2024

There are also other caveats when calculating the carbon intensity of a fixed income portfolio, such as how to treat green bonds. The most common approach is to consider green bonds as vanilla bonds, and use the issuer level carbon emission data. However, despite benefiting from the credit worthiness of their issuers, green bonds are normally earmarked for specific green projects. Considering their positive impact on carbon reduction and/or avoidance, green bond carbon intensity may differ from that of their vanilla counterparts. In practice, some investors have adopted novel approaches to treat green bonds differently by discounting the carbon intensity or owned emissions[37] while taking the issuer level emission data.

Despite their relatively small presence in the global bond market, green bonds are scaling rapidly. In the FTSE WorldBIG Corp, the total green bond weight has increased from 0.6% in 2016 to over 4% in 2022. As the green bond market continues to grow and bond-level impact data becomes more accessible, treating the green bonds more granularly could further reduce the overall carbon intensity of a corporate fixed income portfolio that has green bond exposures.

[36] LSEG. (2024) Tracing Carbon-intensive Bonds. Available at: https://www.lseg.com/content/dam/lseg/en_us/documents/sustainability/tracing-carbon-intensive-debt-lseg.pdf. (Accessed: 12 August 2024)

[37] Allianz. (2023) Allianz Portfolio Carbon Footprint Methodology. Available at: https://www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/sustainability/documents/Allianz_Portfolio_Carbon_Footprint_Methodology.pdf. (Accessed 25 August 2024)

3. Attributing changes to portfolio exposure

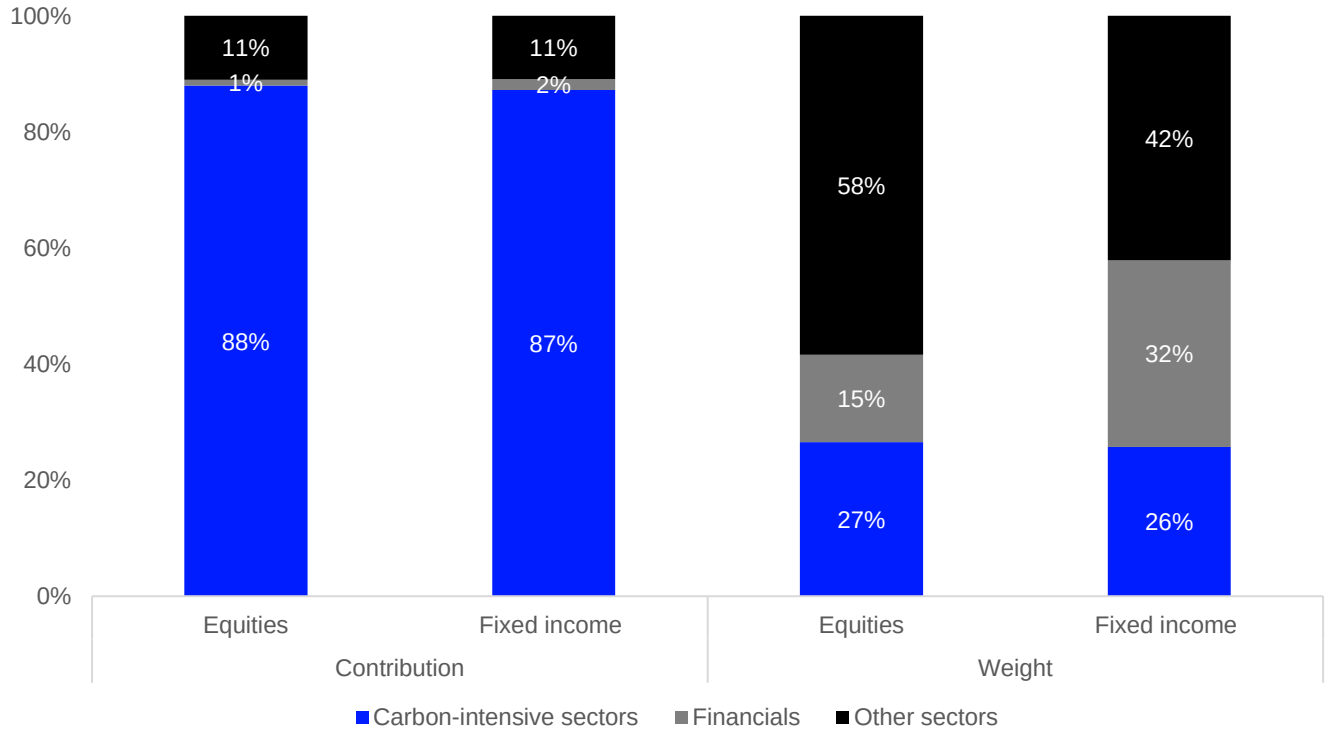
3.1 HOW SECTORAL COMPOSITION IMPACTS PORTFOLIO METRICS

Building on our analysis of various emissions metrics, it is critical for investors and regulators to analyse how sectoral composition and concentration shape the emissions profile of both equity and fixed income markets.

Despite having comparable concentrations of carbon-intensive sectors, including Utilities, Basic Materials, Energy, and Industrials, global equity and fixed income benchmarks have distinct sectoral compositions. Focusing on 2022, although carbon-intensive sectors represent only 27% of the equity benchmark, they contribute 88% of total absolute emissions. This is similar to the fixed income benchmark, where 26% of the universe account for 87% of absolute emissions (see figure 19). The disproportionate impact of the weights of carbon-intensive sectors on total emissions, highlights the importance of targeting emission reduction within these sectors as they hold the most potential to reduce portfolio emissions.

Figure 19: Carbon-intensive sectors are equally concentrated in equity and fixed income benchmarks

Absolute emissions contribution and sectoral composition, equities and fixed income, 2022



Source: LSEG, August 2024

Considering sectoral composition within each universe, Technology firms dominate equities, due to their substantial market capitalisation. In contrast, Financials dominate the fixed income benchmark, comprising over 30% of all in-scope index constituents and reflecting their positions as the largest bond issuer within corporate sectors[38] (see figure 20).

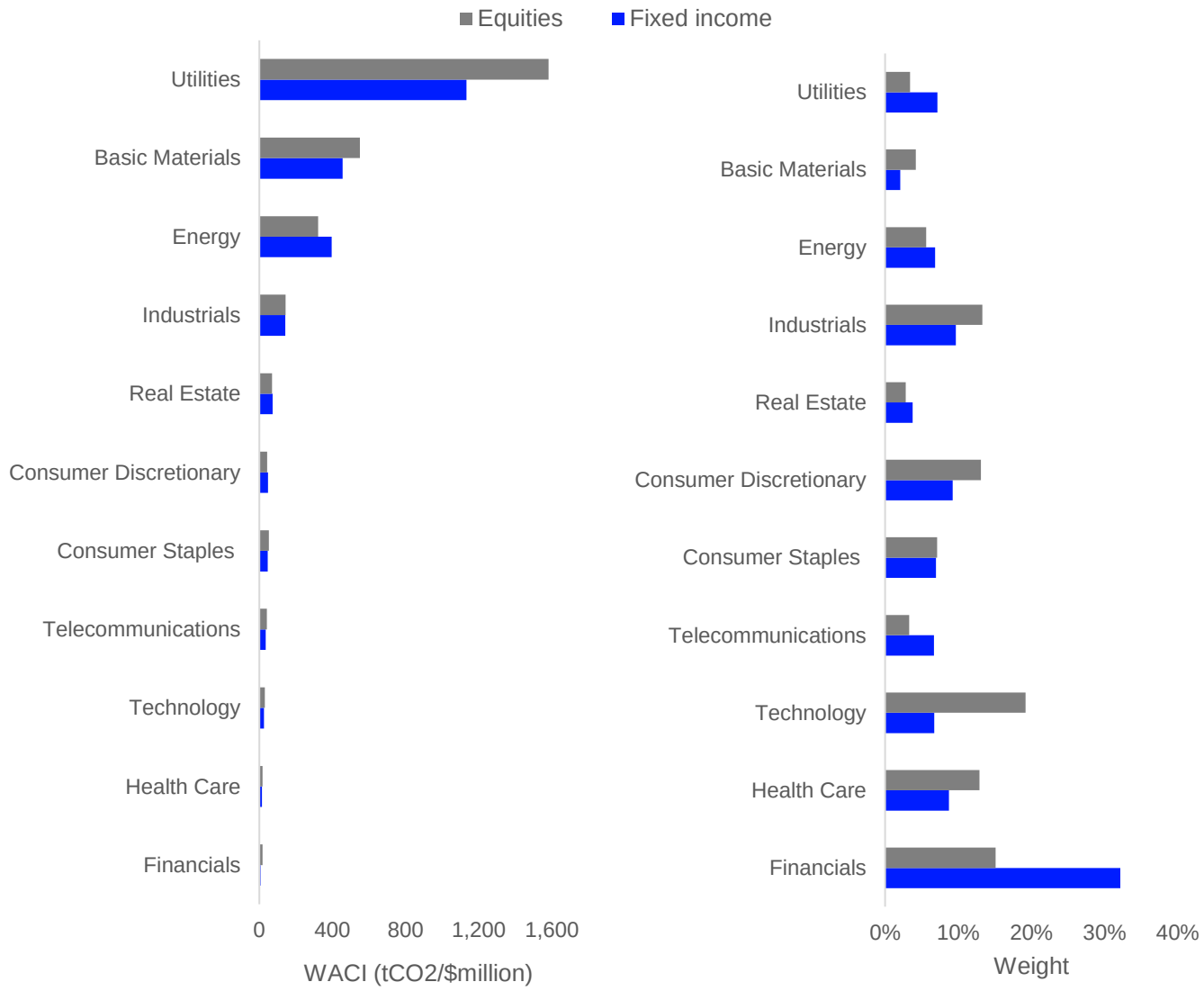
The WACI varies significantly across sectors, however, within individual sectors the WACI of fixed income and equities are aligned closely, with the exception of the Utilities sector, where the WACI in the fixed income benchmark is 28% lower than that in equities (see figure 20). This discrepancy primarily stems from the fact that the Utilities sector in fixed income is over 90% weighted towards developed markets[39] – where transition is more advanced than their emerging market peers, while utility companies in the equity universe are more diversified.

[38] ICMA. (2020) *'Bond Market Size'*. Available at: https://www.icmagroup.org/market-practice-and-regulatory-policy/secondary-markets/bond-market-size/ (Accessed:10 August 2024)

[39] This concentration is largely due to the selection of benchmark, where FTSE WorldBIG index only accepts bonds that are rated by major international rating agencies and therefore emerging markets' locally issued bonds which do not carry such ratings are exclude from the index. Detailed index criteria are available at: https://www.lseg.com/en/ftse-russell/index-resources/factsheets

Figure 20: Comparing sectoral WACI and compositions between equities and fixed income, 2022

WACI and sectoral composition, equities and fixed income, 2022



Source: LSEG, August 2024

Our analysis of portfolio carbon intensities (i.e., WACI and carbon intensity by EVIC) shows that intensities are heavily influenced by changes in carbon-intensive sectors. For instance, Utilities only reflect c. 3% of index weight in the equity benchmark, but make up about 40% of portfolio WACI, significantly greater than its 30% and 25% contributions to carbon intensity by market cap and EVIC respectively. Similarly, the Utilities sector is the primary contributor to the carbon intensity of the fixed income benchmark, and accounts for nearly 55% of index WACI and 36% contribution to carbon intensity (EVIC) (see figures 45 and 46 in Appendix III).

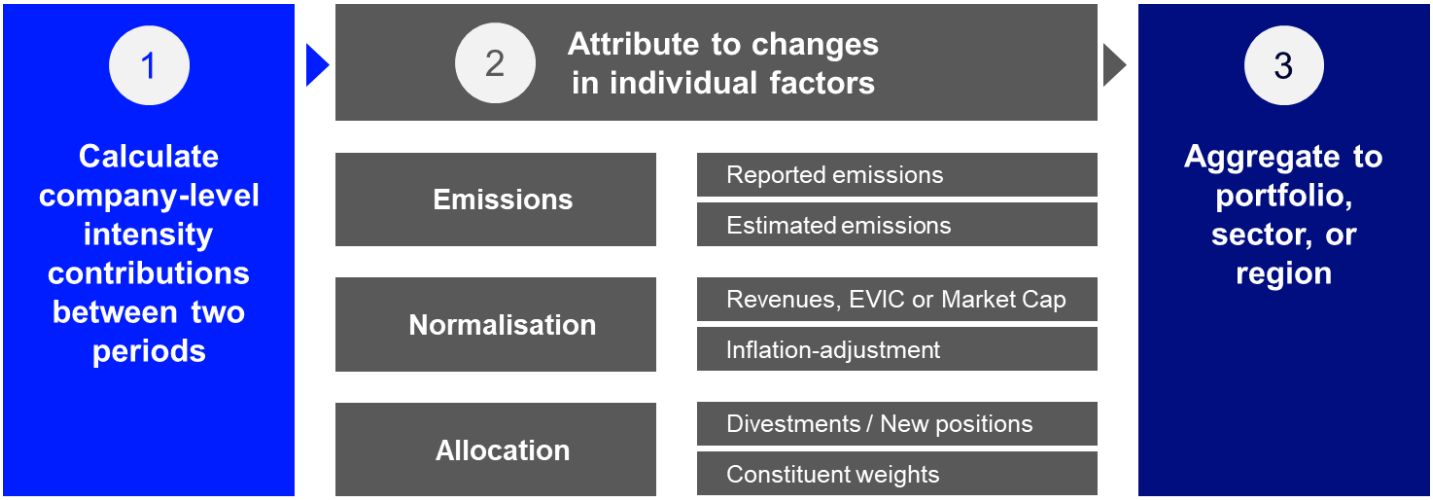
Despite comprising a small proportion of the overall index weight, a minor weight rotation towards Utilities and other carbon intensive sectors can therefore significantly impact overall portfolio carbon intensity results. This can make portfolio level intensity particularly sensitive to changes in the component factors (i.e., carbon emissions, index weight, and intensity normalisation factors).

3.2 PORTFOLIO ATTRIBUTION APPROACH

Changes in portfolio carbon intensities are driven by a complex interplay of underlying factors. Deconstructing these factors helps unveil the different offsetting dynamics that contribute to year-on-year swings in carbon intensities. By employing logarithmic ratios of past and current values for each factor (detailed in Appendix IV), we can decompose the contributions of each constituent to the changes in the underlying multiplicative factors – index weight, carbon emissions, and normalisation factors (e.g. revenues for WACI).

This approach (illustrated in figure 21) can be tailored for different carbon intensity metrics, with breakout elements available for each factor.[40] Overall, the key aim of the attribution analysis is to understand real decarbonisation at the portfolio level by deconstructing and distinguishing the impact of changes in carbon emissions, normalisation factors, and allocation effects on intensity metrics.

Figure 21: Contribution analysis breaks down factor influences on a constituent level



Source: LSEG, August 2024

3.3 PORTFOLIO ATTRIBUTION – EQUITIES

The 3.8% reduction in WACI observed between 2021[41] and 2022 is attributable to the changes in the individual factors as follows (see figure 22):

- **Emissions:** changes in emissions of constituents have driven a 1.1% net increase in portfolio WACI, out of which a 0.4% decrease stems from emissions of disclosing firms, which is overshadowed by a 1.5% increase deriving from estimates alone.
- **Normalisation:** changes in the real revenues (i.e., nominal firm revenues adjusted for inflation) resulted in a 10.7% net decrease in portfolio WACI. Out of this, nominal revenues have driven a 15.9% reduction in portfolio WACI, with the remainder 5.2% increase influenced by inflation adjustment.
- **Allocation:** allocation effects contributed a 13.5% net increase to portfolio WACI, which is mostly dominated by changing weights of constituents causing a 14.7% increase and marginally offset by a 1.3% decrease from constituent churn from divestments and new positions.

The 0.1% reduction in Carbon Intensity by EVIC observed between 2021 and 2022 is attributable to the changes in the individual factors as follows (see figure 23):

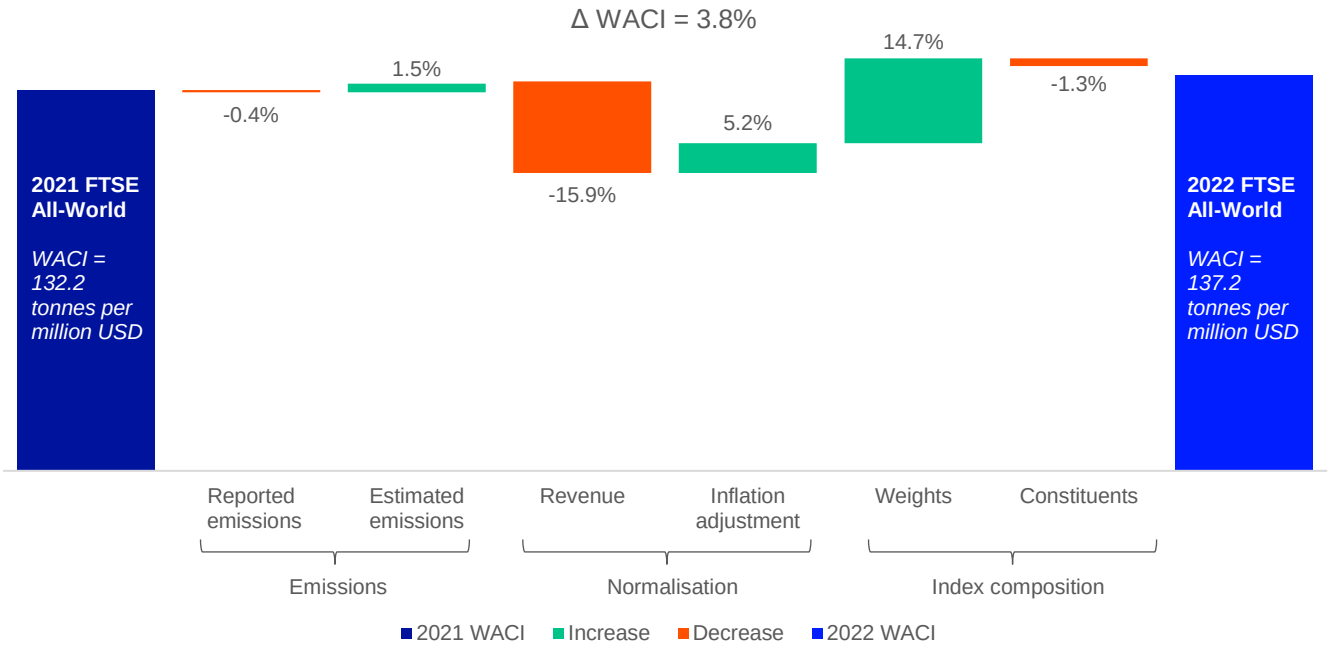
- **Emissions:** changes in emissions of constituents have driven a 1.2% net reduction in portfolio Carbon Intensity (EVIC), out of which a 1.5% decrease stems from emissions of disclosing firms, with the remainder being a 0.3% from estimates.
- **Normalisation:** changes in the real EVIC resulted in a 10.5% net decrease in Carbon Intensity (EVIC). Out of this, nominal revenues have driven a 1.7% increase in Carbon Intensity (EVIC), with the remainder 12.2% decreased influenced by inflation adjustment.
- **Allocation:** allocation effects contributed a 11.6% net increase to portfolio WACI, which is mostly dominated by changing weights of constituents causing a 15.1% increase and offset by a 3.5% decrease from constituent churn.

[40] For example, allocation can be segmented to identify the impact from constituent churn and changing weights, while changes in the nominal values of revenues, EVIC, and market cap can be separated from the impact of inflation adjustment.

[41] This year's results also reflect the impact of new carbon data for FY2021 – specifically from company restatements and new emissions data sources since last year's report was published.

Figure 22: Disaggregating equity portfolio WACI changes for Scope 1 and 2[42]

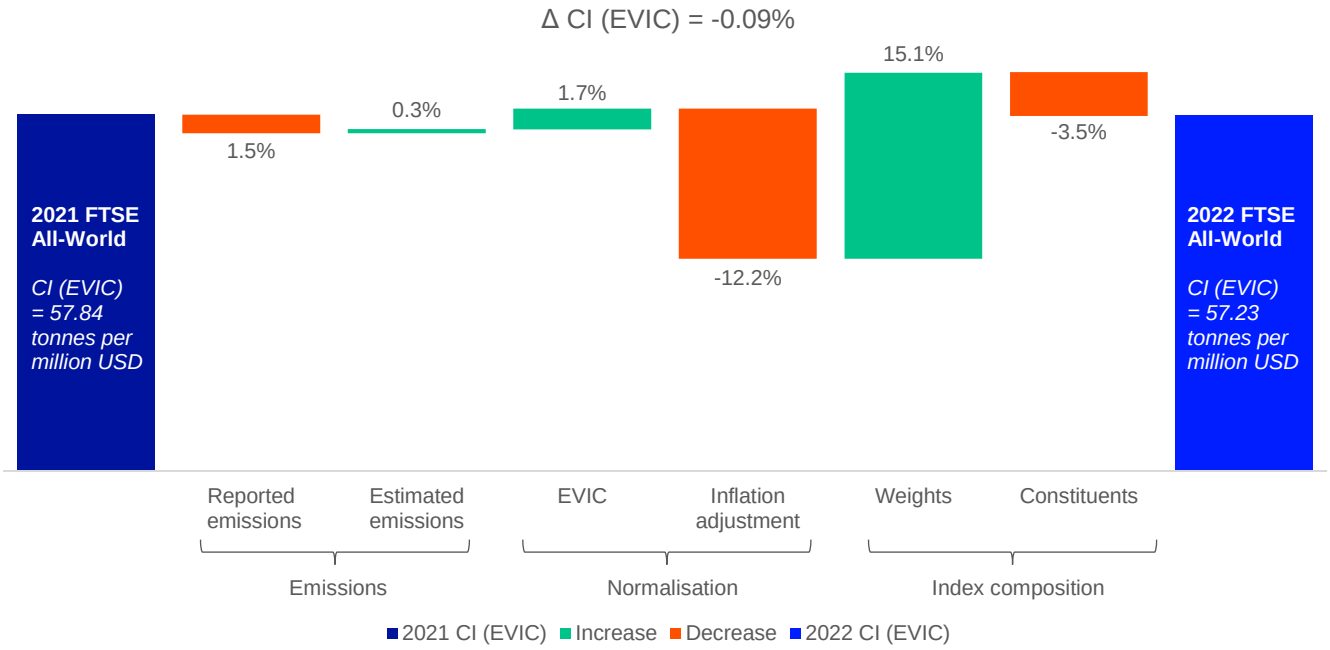
Contribution by category to the change of WACI (2021–2022)



Source: LSEG, August 2024

Figure 23: Disaggregating equity portfolio Carbon Intensity (EVIC) changes for Scope 1 and 2[43]

Contribution by category to the change of Carbon Intensity (EVIC) (2021–2022)



Source: LSEG, August 2024

[42] Please note that discrepancies may exist between the carbon intensity figures cited in this report and those in FTSE Russell index reporting - where FTSE All World Index is the benchmark. These variances are mainly attributable to several factors, including variations in the sources of emission data and financial data (refer to Appendix V for details on data sources in this research), differences in cut-off dates used for this research and index reporting, as well as the choice of base year for inflation adjustment.

[43] Ibid.

The attribution framework highlights the impact of changes that stem from index constituents on the carbon intensities (see the attribution analysis for market cap in figure 51 in Appendix III). By aggregating these contributions at an industry level (using FTSE Russell's Industry Classification Benchmark),[44] we can better identify the disproportionate impact of various underlying multiplicative factors across different sectors on portfolio intensities. Our sectoral attribution analysis of the changes in portfolio WACI between 2021 and 2022 reveals the following insights (see figure 24):

High carbon industries drive most portfolio level intensity changes

The top-line WACI is mostly shaped by net changes in industries with high carbon emissions *viz*., Energy, Utilities, Basic Materials, and Industrials. This trend is largely due to rising revenues and increasing weights of constituents within these industries between 2021 and 2022.

Increasing revenues in high carbon industries is a primary driver of intensity reduction

The top-line WACI is particularly sensitive to changes in revenues in high carbon industries between 2021 and 2022. Revenues from these industries collectively contributed six times more than revenues from lower carbon industries, such as Consumer Discretionary and Technology, to the observed 11% decrease in portfolio WACI attributed to normalisation.

Sectoral rotation drives portfolio level intensity increase

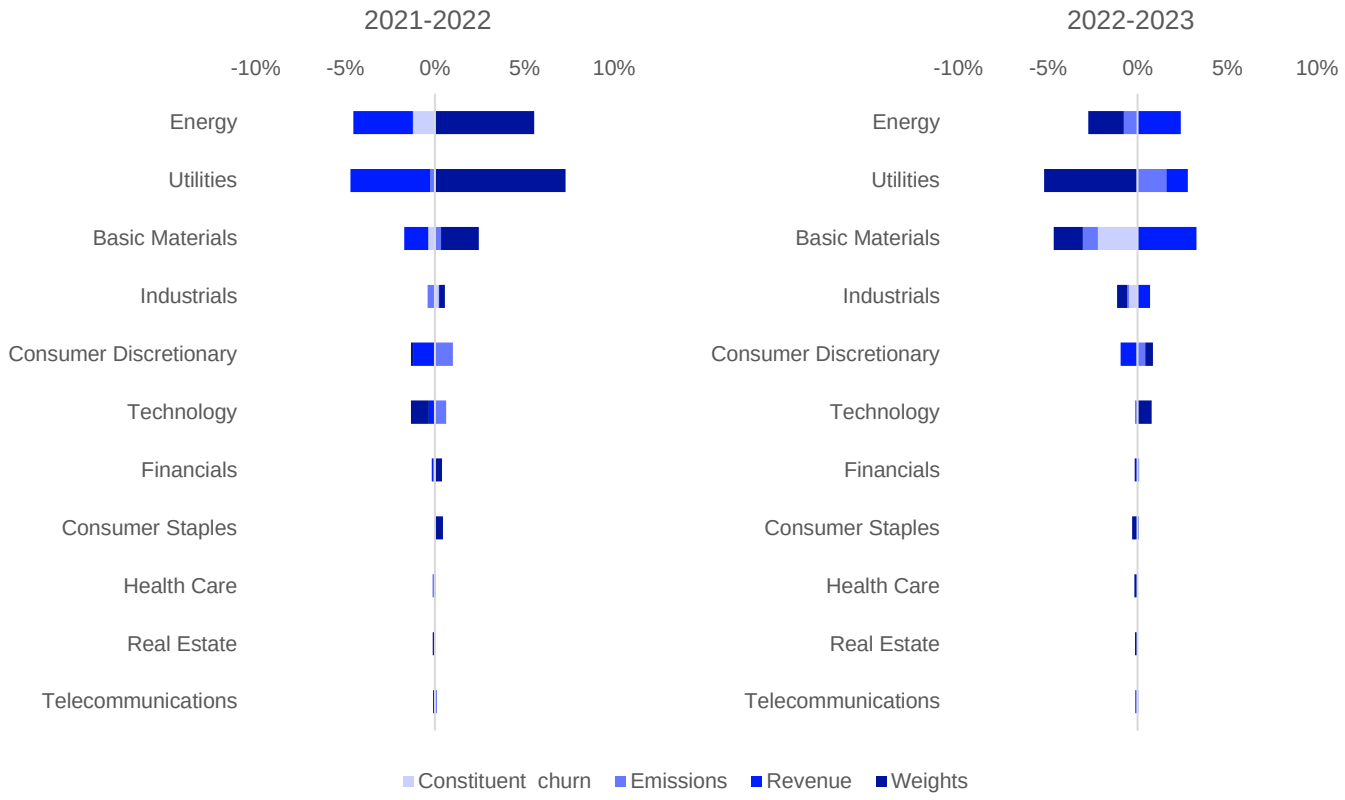
A noticeable shift in sectoral weight allocation is observed between 2021 and 2022, with increases in constituent weights in high carbon industries, though there have also been some movements towards low carbon industries like Financials and Consumer Staples. This sectoral rotation into high carbon industries (contributing 13%) is the primary driver of the observed 14.7 % increase in top-line WACI. This trend changed between 2022 and 2023,[45] marked by decreases in the weights of the Energy, Utilities and Basic Materials, collectively contributing a 7% decline to top line WACI.

The impact of emissions changes on portfolio-level intensities are overshadowed by changes in normalisation factors

The changes from emissions are largely overshadowed by shifts in revenues and constituent weights across most industries. In a few industries, such as, Basic Materials, Technology and Consumer Discretionary, changes in emissions have had noticeable impact on portfolio-level WACI, with emissions increases in these industries contributing to increased portfolio WACI. On the other hand, in sectors like Utilities and Industrials, reductions in emissions have contributed to a decline in portfolio-level WACI, despite increased index weighting. However, this decline is minimal in Utilities but more significant for Industrials.

Figure 24: Weight changes in high-carbon industries deliver the highest contribution

Contributions of portfolio WACI (by revenue) change, by industry



Source: LSEG, August 2024

[44] Industry Classification Benchmark (ICB), FTSE Russell, accessed 08/08/2024

[45] Corporate reported carbon emissions data is only available for the full universe up until FY2022. We have nonetheless included the sectoral contribution analysis for FY2023 (i.e. 2022 – 2023 sectoral attribution analysis) based on revenue estimates and historical emissions data.

3.4 PORTFOLIO ATTRIBUTION – FIXED INCOME

By applying the same attribution analysis approach to fixed income and deconstructing the underlying attribution factors related to changes in carbon intensity, the findings indicate:

– Normalisation factors (in both revenues and EVIC) were the primary drivers of the fixed income carbon intensity reduction during the 2021 – 2022 period. Specifically, changes in nominal revenues led to a 15.4% reduction in the fixed income portfolio's WACI, with the inflation adjustment resulted in a 4.9% increase (see figure 25). Consequently, changes in the real revenues – indicative of the post-pandemic economic recovery – resulted in a 10.5% net decrease in fixed income WACI, whereas decrease in constituents' emission have only contributed marginally (led to a 0.3% reduction in the overall WACI).

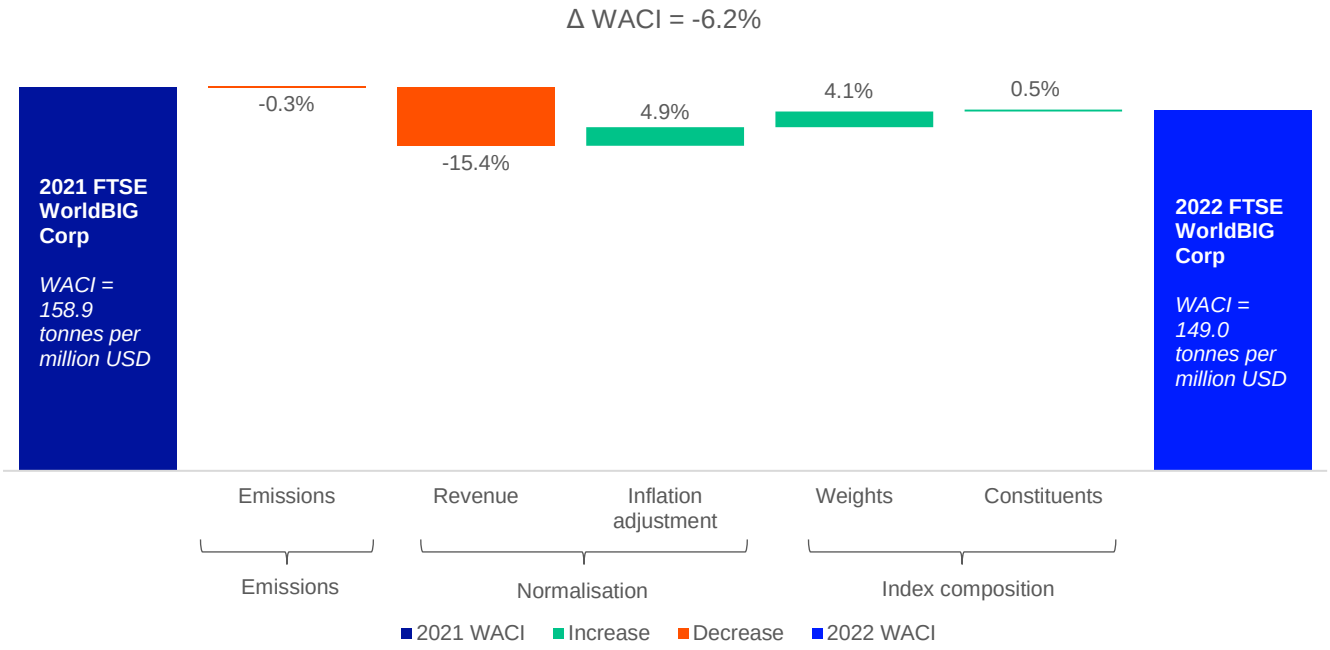
– Although normalisation factors influence WACI in the fixed income and equity portfolios similarly, they impact carbon intensity (EVIC) differently. The EVIC inflation adjustment in fixed income led to a 5.3% reduction of the fixed income portfolio's carbon intensity (EVIC) (see figure 26), smaller than the attributed 12.2% reduction in equity. This difference is partly due to the 'consistent constituents-based approach' used in fixed income EVIC adjustment (see Box 2).

– Changes in index compositions had a smaller impact on the changes in fixed income carbon intensity, reflecting lower level of volatility of par value-based weighting in fixed income compared to the market cap-based weighting in equities.

– The sectoral attribution analysis indicates carbon-intensive sectors are the main drivers of fixed income portfolio decarbonisation during the 2021-2022 period. Changes in normalisation factors, notably the rapid revenue growth in these sectors, played a key role in driving down the carbon intensity. These trends align with similar patterns observed in the equity portfolio (see fixed income sectoral attribution analysis in figure 53 in Appendix III).

Figure 25: Disaggregating fixed income portfolio WACI changes for Scope 1 and 2[46]

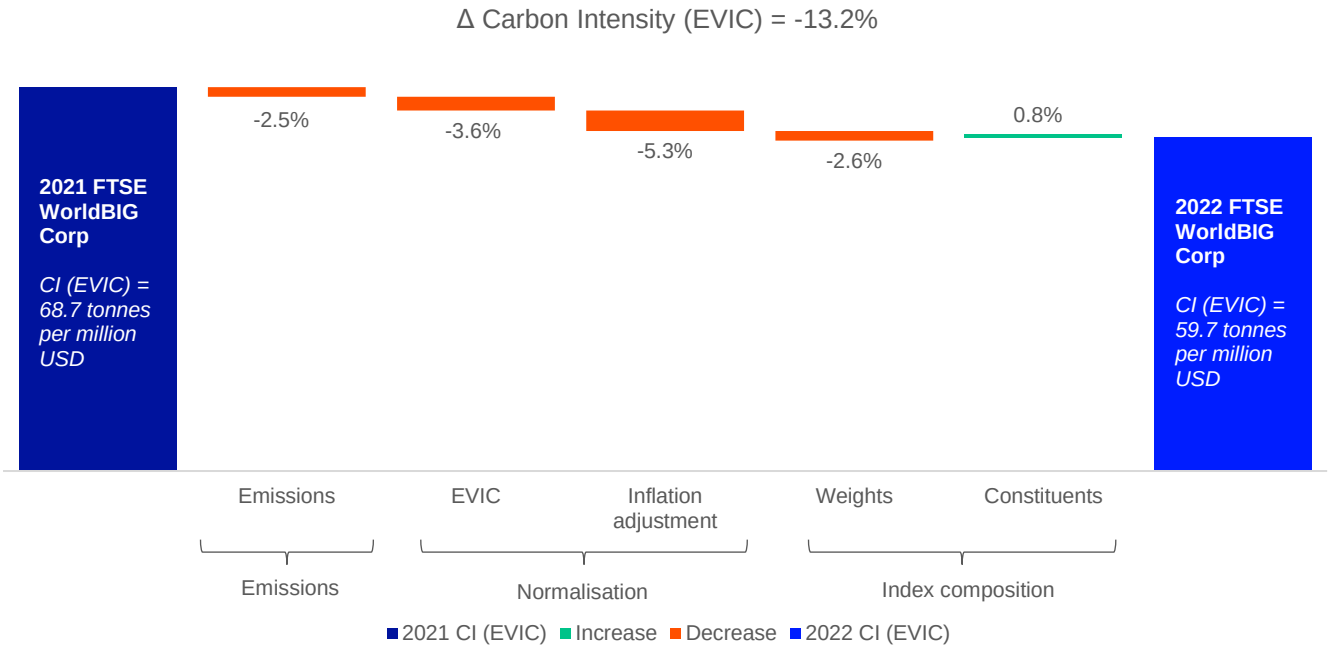
Contribution by category to the change of WACI (2021–2022)



Source: LSEG, August 2024

Figure 26: Disaggregating fixed income portfolio Carbon Intensity (EVIC) changes for Scope 1 and 2[47]

Contribution by category to the change of Carbon Intensity (EVIC) (2021–2022)



Source: LSEG, August 2024

[46] Please note, discrepancies may exist between the carbon intensity figures presented in this report and those in FTSE Russell index reporting - where FTSE WorldBIG Corp index is the benchmark. The differences can be attributed to several factors, including variations in the sources of emission data and financial data (refer to Appendix V for details on data sources in this research), differences in cut-off dates used for this research and index reporting, as well as the choice of base year for inflation adjustment.

[47] Ibid.

4. Scope 3 emissions

Scope 3 emissions are a key consideration for investors assessing climate risk at the portfolio level, as they typically represent the largest share of a company's carbon footprint, averaging four times higher than Scope 1 and 2 emissions combined.[48] These emissions have gained even greater focus recently due to the increasing adoption of the ISSB and other regulatory frameworks such as the EU Corporate Sustainable Reporting Directive, which mandate their inclusion in corporate disclosures,[49] as well as standard-setting publications from the PCAF[50] and the Net Zero Investment Framework[51] (NZIF).

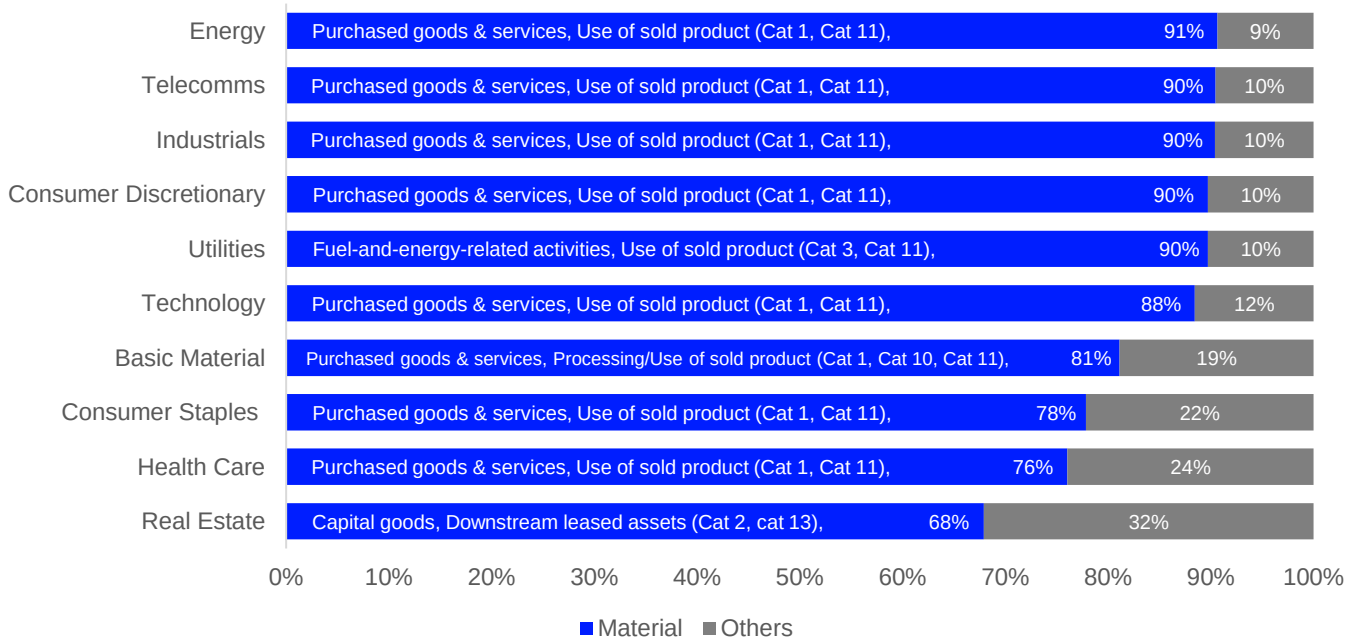
However, investors face significant challenges in accurately calculating and tracking Scope 3 emissions for their portfolios, particularly due to gaps in data quality and an underreporting of material emissions sources. This resulting uncertainty in true emissions levels makes it challenging for investors to accurately quantify Scope 3 exposure and set meaningful decarbonisation targets.

In early 2024, FTSE Russell published a report on how to address these challenges.[52] The report shows that the majority of emissions can be captured using only the two most material categories in Scope 3 disclosures, about 80% of emissions in each sector (see figure 27), with the majority of industries almost fully captured with the same two categories, Purchased Goods & Services and Use of Sold Products. The exclusion of disclosures that do not include these material categories significantly enhances the utility of portfolio-level scope 3 analysis by reducing top-level volatility and increasing overall estimate precision.

Systematically applying this classification to a large sample of companies aims to enhance the utility of portfolio-level carbon analyses, by both increasing estimate precision. For example, figure 28 compares the Supersector carbon intensities based on material scope 3 disclosures (left y-axis) and their sector disclosure rates (right y-axis) with index weights (x-axis) for 2022. It shows that the contribution of Scope 3 intensive sectors that have relatively limited index weight (Energy, Utilities, Automobiles and Parts) to the final index's carbon intensity is significant compared to larger, but less Scope 3 intensive sectors (Technology and Health Care).

Figure 27: Purchased goods & services, Use of sold product capture majority of material scope 3 emissions across industries

Share of emissions of the most material categories in each industry's Scope 3 intensity



Source: LSEG, August 2024

[48] See Fouret, F., Olesiewicz, M. & Haalebos, R. (2024). Scope for improvement: Solving the Scope 3 conundrum. FTSE Russell. Available at: https://www.lseg.com/en/ftse-russell/research/solving-scope-3-conundrum (Accessed: 01/092024)

[49] See Conundrum Cubed: Scope 3 for Financials | CFA Institute Enterprising Investor (Accessed: 01/09/2024)

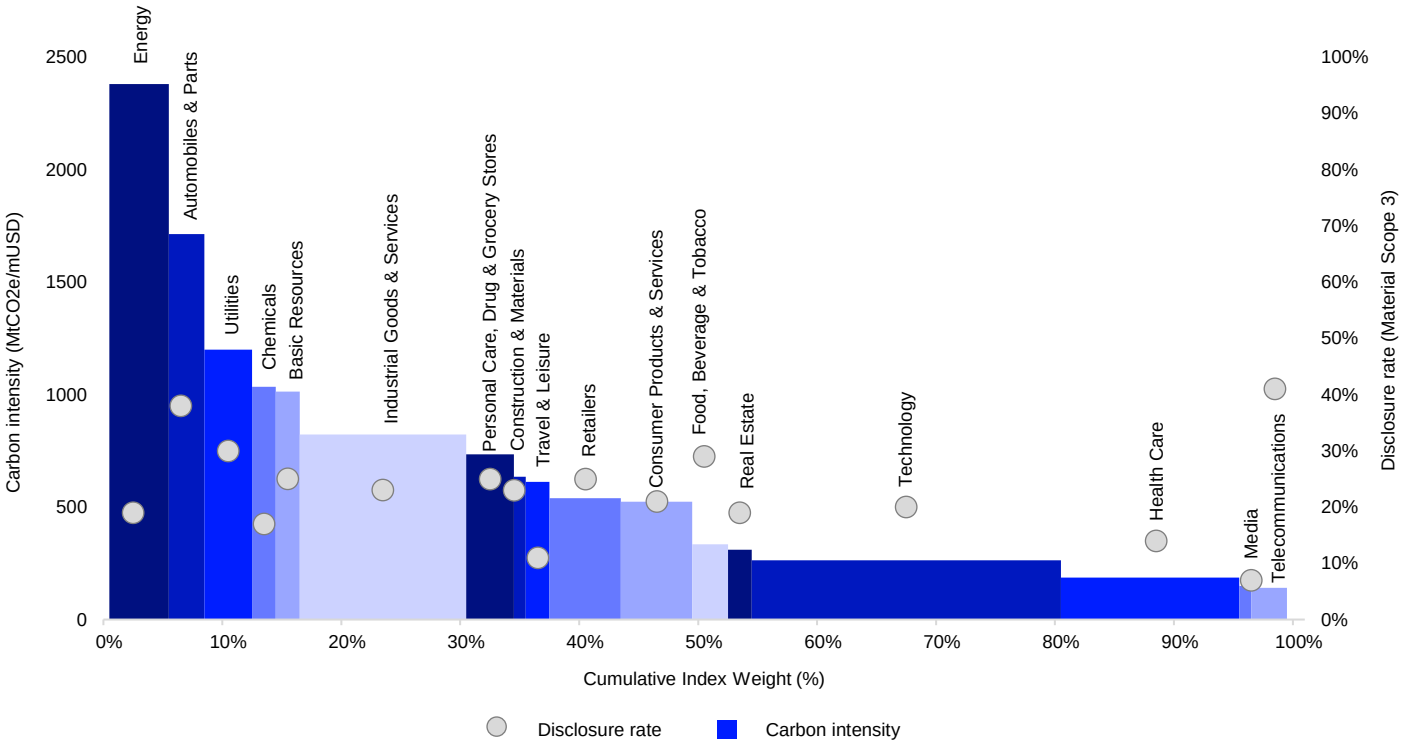
[50] See The Global GHG Accounting and Reporting Standard for the Financial Industry (PCAF, 2022) (Accessed: 01/09/2024)

[51] See Investor approaches to scope 3 (IIGCC, 2024) (Accessed: 01/092024)

[52] See Fouret, F., Olesiewicz, M. & Haalebos, R. (2024). Scope for improvement: Solving the Scope 3 conundrum. FTSE Russell. Available at: https://www.lseg.com/en/ftse-russell/research/solving-scope-3-conundrum (Accessed: 01/092024)

Figure 28: The contribution of heavy-emitting sectors to portfolio intensity is significant compared to other sectors despite comparable disclosures

Scope 3 carbon intensity (2022 median) with corresponding disclosure rates and index weights by Supersector



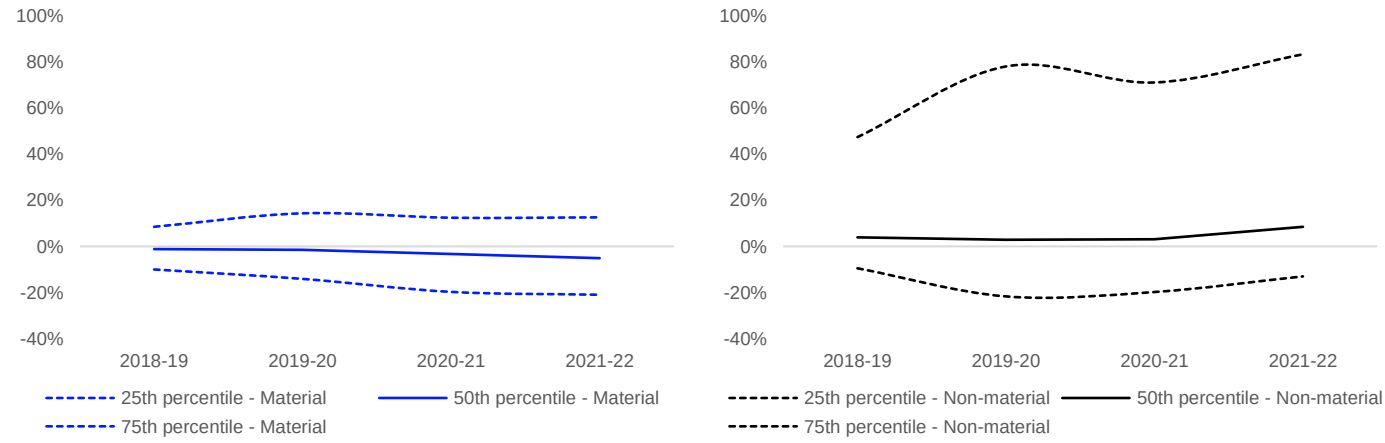
Source: LSEG, August 2024

A significant source of volatility in scope 3 data is companies that either start or stop disclosing Scope 3 data or adjust the categories that they are reporting on. Focusing on material categories can therefore significantly reduce volatility and limit noise in Scope 3 data.

In 2022, companies that consistently provide material Scope 3 disclosures exhibit a much lower annual volatility than companies that exclude these categories from their disclosures (17% and 31%, respectively, see figure 30). Separating companies disclosing on their material categories, we see that Scope 3 disclosures that do not cover material categories also trend upwards over time, with 25 percent of non-material reporters companies increasing their emissions by over 80% between 2021 and 2022 (see figure 29).

Figure 29: Material scope 3 intensity less volatile less divergent compared to non-material intensity

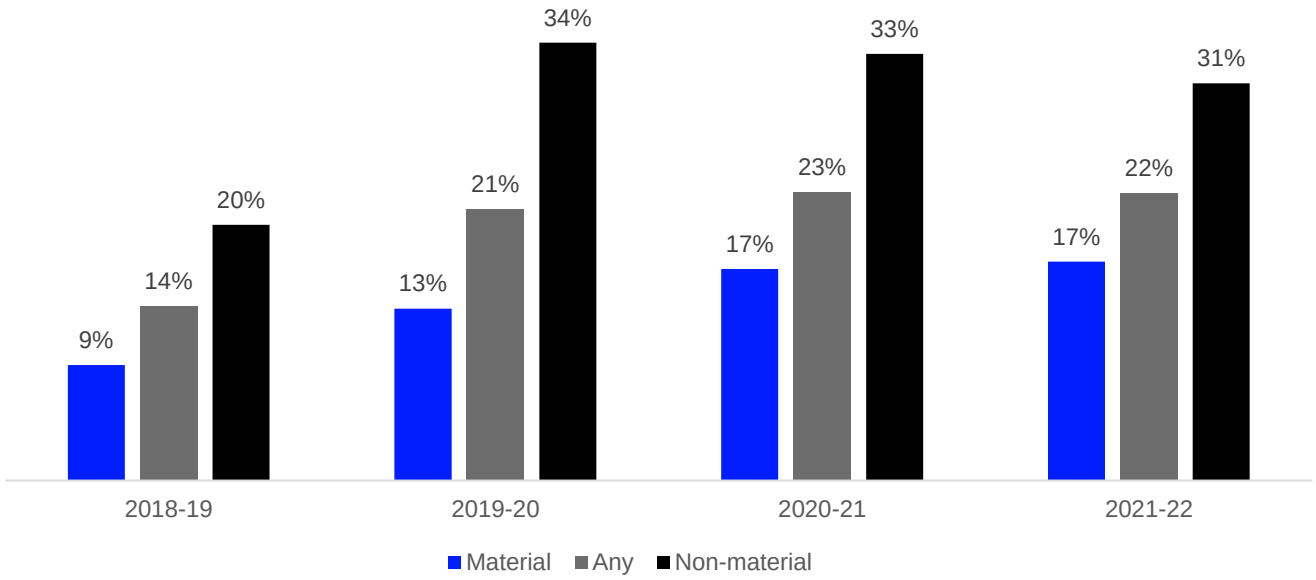
Median, the 25th and 75th percentiles y-o-y changes of Scope 3 carbon intensities, Material vs Non–Material Scope 3



Source: LSEG, August 2024

Figure 30: Material scope 3 emissions exhibit less volatility

Median of absolute year over year change in reported Scope 3 data 2018-2021

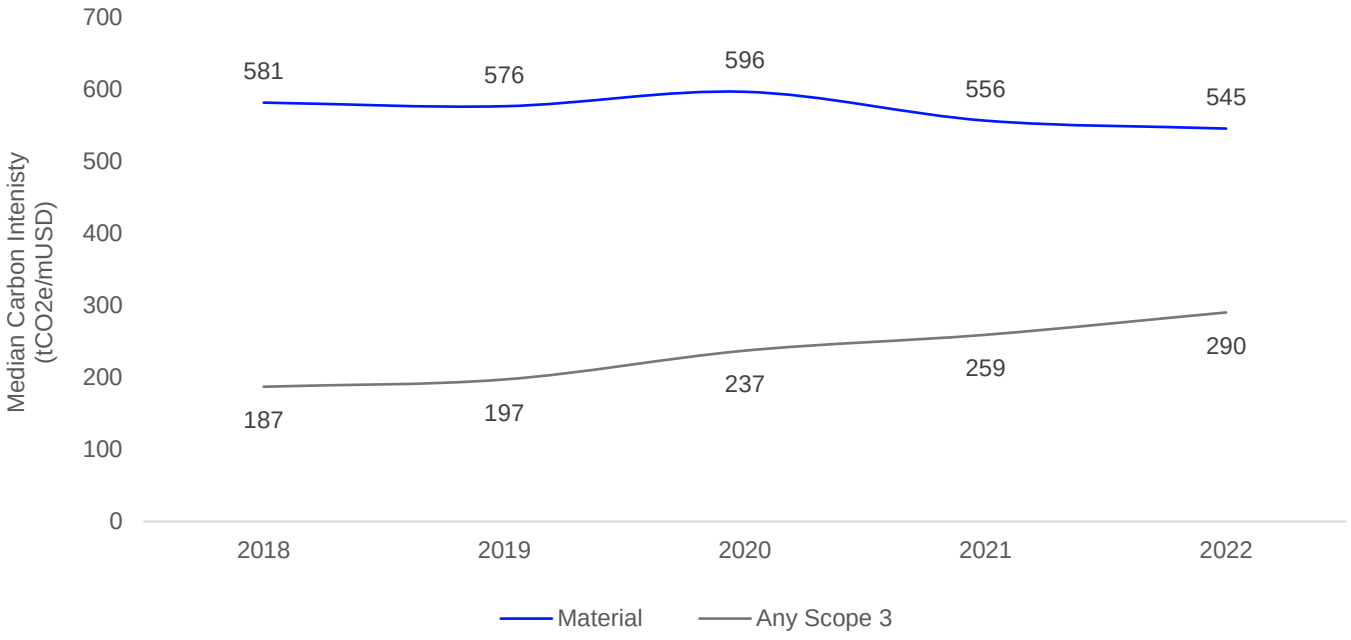


Source: LSEG, August 2024

If underreporting of material categories is permitted on the constituent level, emissions are underestimated at the portfolio level. Within large and mid-cap stocks, focusing on the material disclosures reveals that the median Scope 3 emissions intensity is likely to be twice as high as suggested by using all Scope 3 disclosures (see figure 31).

Figure 31: Significant gap between material and non-material scope 3 intensity

FTSE All World Scope 3 median carbon intensity 2018-2022



Source: LSEG, August 2024

Appendix I. Data and aggregated metrics

Figure 32: Common carbon metrics for portfolio (Scope 1&2)[53] of FTSE All-World index[54]

	2015	2016	2017	2018	2019	2020	2021	2022
Aggregate Emissions (million tonnes)	9,026	9,448	10,085	10,482	11,017	10,715	11,820	11,180
WACI (tonnes per million USD sales)	158	177	155	160	147	135	132	137
Carbon Intensity (EVIC) (tonnes per million USD invested)	74	79	79	82	66	58	58	58
Carbon Intensity (Market Cap) (tonnes per million USD invested)	145	147	152	153	121	113	111	103
Median Carbon Intensity (tonnes per million USD)	35	34	32	29	29	30	30	32
Median Carbon Intensity (EVIC) (tonnes per million USD invested)	17	17	17	16	15	13	13	13
Median Carbon Intensity (Market Cap) (tonnes per million USD invested)	23	22	23	24	22	20	21	21

Figure 33: Regional breakdown of WACI and Median Carbon Intensity (Scope 1&2, in 2022) of FTSE All-World Index[55]

	WACI	Median Carbon Intensity	Weight in Index
All Region	137	32	100%
China	213	40	3.7%
Developed Asia Pacific	133	38	11.2%
Developed Europe	88	16	16.5%
Emerging Asia, Middle East & Africa (ex China)	377	86	5.8%
Emerging Europe	425	46	0.2%
Latin America	200	50	1.1%
North America	122	20	61.6%

[53] When WACI is taken for a subgroup – such as a particular region or sector – weights are renormalised to obtain a sum of 100% for that subgroup. Therefore, an increasing WACI for a subgroup will indicate either 1) changing carbon intensity of constituents, or 2) increase of weight carbon-intense constituents.

[54] EVIC data used in Carbon intensity calculation have been adjusted for inflation using the methodology outlined in the EU Handbook for Paris Aligned Benchmarks.

[55] Please note that discrepancies may exist between the carbon intensity figures cited in this report and those in FTSE Russell index reporting - where FTSE All World Index is the benchmark. These variances are mainly attributable to several factors, including variations in the sources of emission data and financial data (refer to Appendix V for details on data sources in this research), differences in cut-off dates used for this research and index reporting, as well as the choice of base year for inflation adjustment.

Figure 34: Industrial breakdown of WACI and Median Carbon Intensity (Scope 1&2, in 2022) of FTSE All-World Index

	WACI	Median Carbon Intensity	Weight in Index
All Industry	137	32	100%
Basic Materials	550	361	4.2%
Consumer Discretionary	43	24	13.1%
Consumer Staples	52	54	7.1%
Energy	322	258	5.6%
Financials	17	3	15.%
Health Care	17	22	12.9%
Industrials	144	36	13.3%
Real Estate	70	40	2.8%
Technology	30	11	19.2%
Telecommunications	41	38	3.3%
Utilities	1,582	514	3.4%

Figure 35: Common carbon metrics for portfolio (Scope 1&2) of FTSE WorldBIG Corp[56]

	2016	2017	2018	2019	2020	2021	2022
Aggregate Emissions (million tonnes)	4,229	4,438	4,530	4,414	4,061	4,472	4,450
WACI (tonnes per million USD sales)	189	168	168	160	162	159	149
Carbon Intensity (EVIC) (tonnes per million USD invested)	65	69	72	68	65	69	60
Median Carbon Intensity (tonnes per million USD)	32	31	28	27	22	24	22
Median Carbon Intensity (EVIC) (tonnes per million USD invested)	10	10	9	8	7	7	8

Figure 36: Regional breakdown of WACI and Median Carbon Intensity (Scope 1&2, in 2022) of FTSE WorldBIG Corp

	WACI	Median Carbon Intensity	Weight in Index
All Region	149	22	100%
China	73	19	1.6%
Developed Asia Pacific	131	41	4.2%
Developed Europe	94	17	28.9%
Emerging Asia, Middle East & Africa (ex China)	635	78	0.7%
Emerging Europe	660	167	0.1%
Latin America	188	147	0.6%
North America	171	21	63.9%

[56] Please note, discrepancies may exist between the carbon intensity figures presented in this report and those in FTSE Russell index reporting – where FTSE WorldBIG Corp index is the benchmark. The differences can be attributed to several factors, including variations in the sources of emission data and financial data (refer to Appendix V for details on data sources in this research), differences in cut-off dates used for this research and index reporting, as well as the choice of base year for inflation adjustment.

Figure 37: Industrial breakdown of WACI and Median Carbon Intensity (Scope 1&2, in 2022) of FTSE WorldBIG Corp

	WACI	Median Carbon Intensity	Weight in Index
All Industry	149	22	100%
Basic Materials	456	298	2.1%
Consumer Discretionary	47	18	9.2%
Consumer Staples	47	49	6.9%
Energy	396	243	6.8%
Financials	7	3	32.2%
Health Care	15	14	8.7%
Industrials	142	28	9.7%
Real Estate	72	35	3.8%
Technology	26	9	6.7%
Telecommunications	34	28	6.7%
Utilities	1,132	568	7.2%

Appendix II. Carbon accounting and carbon exposure metrics

In addition to differences that can arise from different data sources (e.g., reported carbon data, estimated carbon data, revenues, enterprise value, market capitalisation), there are several methodological choices involved in the construction of carbon exposure metrics:

Normalisation factors are often applied to absolute emissions to obtain carbon intensity, increasing comparability between companies and over time. The most common normalisation factors are as follows:

- Revenues: Annual revenues generated during the same time period of emissions provide a universal measure of company output or activity across the investable universe. However, revenues are not a perfect proxy for output across sectors and revenue intensities are sensitive to price changes between sectors or over time (e.g., inflation).
- Market value metrics:
  - Enterprise value including cash (EVIC): By dividing emissions by EVIC, the resulting metric links emissions directly to the value of the company an investor owns, rather than tying them to an 'output' metric such as revenues. However, this also exposes the intensity measure to volatility in market valuations, while also rewarding higher debt levels.
  - Market capitalisation: By dividing emissions by EVIC, the resulting metric links emissions directly to the value of the company an investor owns, rather than tying them to an 'output' metric such as revenues. However, this also exposes the intensity measure to volatility in market valuations, while also rewarding higher debt levels.
  - Physical units: Carbon intensity in terms of physical production units (e.g., per car or tonne of cement) is often seen as a particularly reliable metric of a company's carbon efficiency. However, these units are sector-specific and will not cover the entirety of the investable universe, limiting the usefulness of physical intensities for inter-sector and portfolio level analysis.

Attribution factors dictate the share of a constituent's emissions, which are included in overall portfolio emissions figures. Where intensity metrics (e.g., WACI) often attribute emissions from each company based on their weight in the portfolio, other metrics calculate the proportion of a firm's activities owned by a portfolio, by dividing the amount invested by total market value of the firm and attributing this proportion of the firm's emissions to the portfolio. The most common attribution factors are as follows:

- Weight: A simple multiplication of portfolio or index weight to the quantity in question.
- Ownership by market capitalisation: This factor captures the current value of a constituent's equity and so is not viable as a metric for fixed income. Allows alignment of individual firms with point-in-time market estimates.
- Ownership by EVIC: EVIC is equivalent to market capitalisation plus debt (cash is kept, avoiding negative values). Point-in-time estimates can be misaligned with respect to market volatility as EVIC values are typically taken for the end of the fiscal year for individual firms.

Inflation adjustments can increase comparability when the meaning of financial values drifts over time. The most common inflation adjustments are as follows:

- Asset values. As asset values (e.g., market capitalisation or EVIC) are generally volatile year over year, the EU Handbook for Paris Aligned Benchmarks[57] suggests that EVIC can be adjusted by dividing the average EVIC of the current year by that of the previous year. In this year's report, we have also treated market capitalisation similarly for the carbon footprint by market cap. A more recent submission has proposed that an asset value inflation factor should be calculated for each individual constituent, based on the changes in its market value since the initial period of analysis.[58]
- Revenues. As purchasing power decreases over time, the value of a constant amount of revenues declines, thus changing the interpretation of carbon efficiency (or carbon intensity by revenues). This can be adjusted either relative to individual currencies or by converting all revenues to US dollars and applying a GDP deflator to the overall time series. Despite these adjustments, revenues – especially for commodity driven sectors like Oil and Gas – can show significant volatility as seen in the commodity volatility throughout 2022.

[57] EU Handbook of Paris-Aligned Benchmarks, accessed 4th September 2024.

[58] Platform on Sustainable Finance's recommendations on data and usability of the EU taxonomy (europa.eu), accessed 4th September 2024.

Figure 38: Carbon Exposure Metrics

Description and mathematical formula for carbon exposure metrics

	Description	Formula
Carbon Emissions Intensity	Normalised rate of carbon emissions per unit of economic activity or asset size. Typically, economic output indicators are used to normalise emissions.	$\text{Carbon Emissions Intensity} = \frac{E_k}{S_k}$ Where E_k is the annual carbon emissions of company k and S_k is the annual output (or size proxy) of company k.
Aggregate Emissions Intensity	Total emissions divided by total revenues of all investee firms	$\text{Aggregate Emissions Intensity} = \frac{\sum_{k=1}^{n} E_k}{\sum_{k=1}^{n} S_k}$ Where E_k is the annual carbon emissions of firm k, and S_k is the annual output of firm k.
Weighted Average Carbon Intensity (WACI)	Portfolio level average of carbon intensity (by revenues) of investee firms, weighted by portfolio exposure	$\text{WACI}_{\text{Revenue}} = \sum_{k=1}^{n} W_k \frac{E_k}{R_k}$ Where E_k is the annual carbon emissions of firm k, R_k is the annual net revenues of firm, and W_k is the weight of firm k in a portfolio such that $\sum_{k=1}^{n} W_k = 1$.[59]
Carbon Intensity by EVIC	Total emissions owned by portfolio through its investee firms, per million USD invested.	$\text{Carbon Intensity (EVIC)} = \frac{\sum_{k=1}^{n}(\frac{(W_k * AUM)}{EVIC_k} * E_k)}{AUM\ (\$M)}$ Where E_k are the carbon emissions of firm k and $EVIC_k$ is the enterprise value including cash of firm k.[60]
Carbon intensity by Market Cap	Total emissions owned by portfolio through its investee firms, per million USD invested.	$\text{Carbon Intensity (market cap)} = \frac{\sum_{k=1}^{n}(\frac{(W_k * AUM)}{Market\ Cap_k} * E_k)}{AUM\ (\$M)}$ Where E_k are the carbon emissions of firm k and $EVIC_k$ is the enterprise value including cash of firm k.[61]

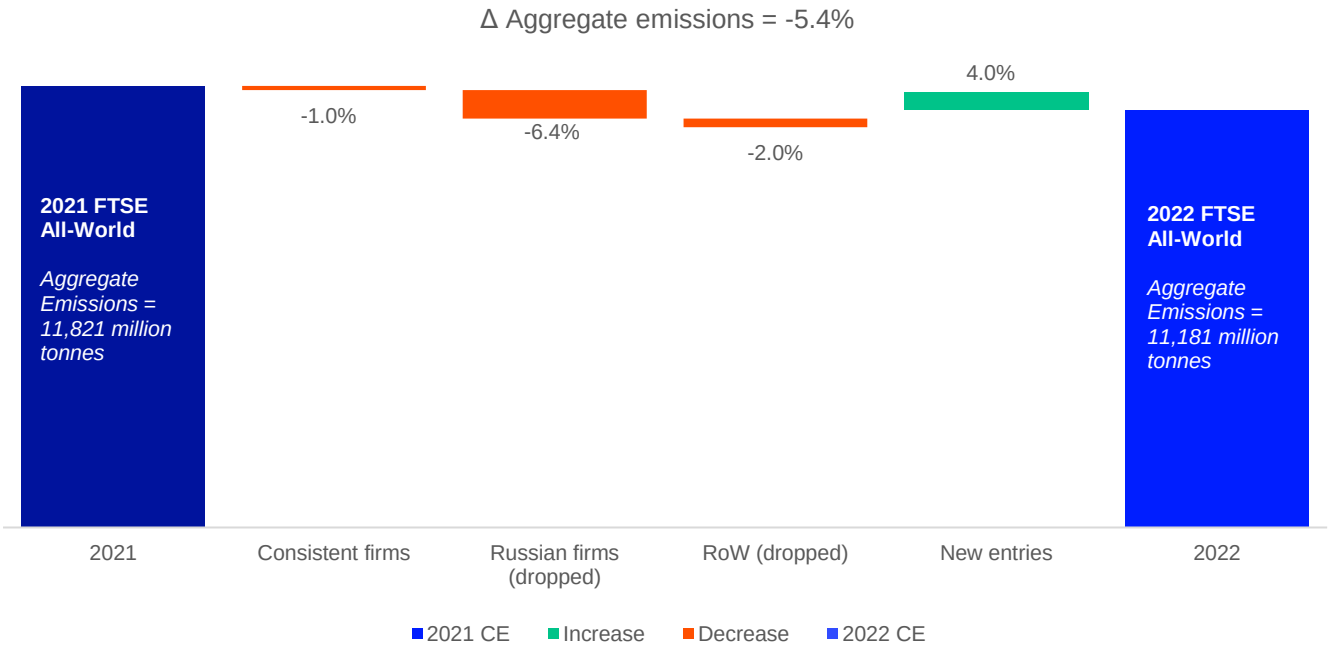
[59] In fixed income, W_k represents the total weights of all bonds issued by firm k that are included in the index.

[60] EVIC is adjusted for annual change in average asset prices according to the methodology outlined in Appendix V. Along with other reported financial data such as revenues, EVIC is taken as of the end of each company's fiscal year.

[61] Market capitalisation is adjusted for annual change in average asset prices according to the methodology outlined in Appendix V. Market capitalisation is sampled at the end of each calendar year.

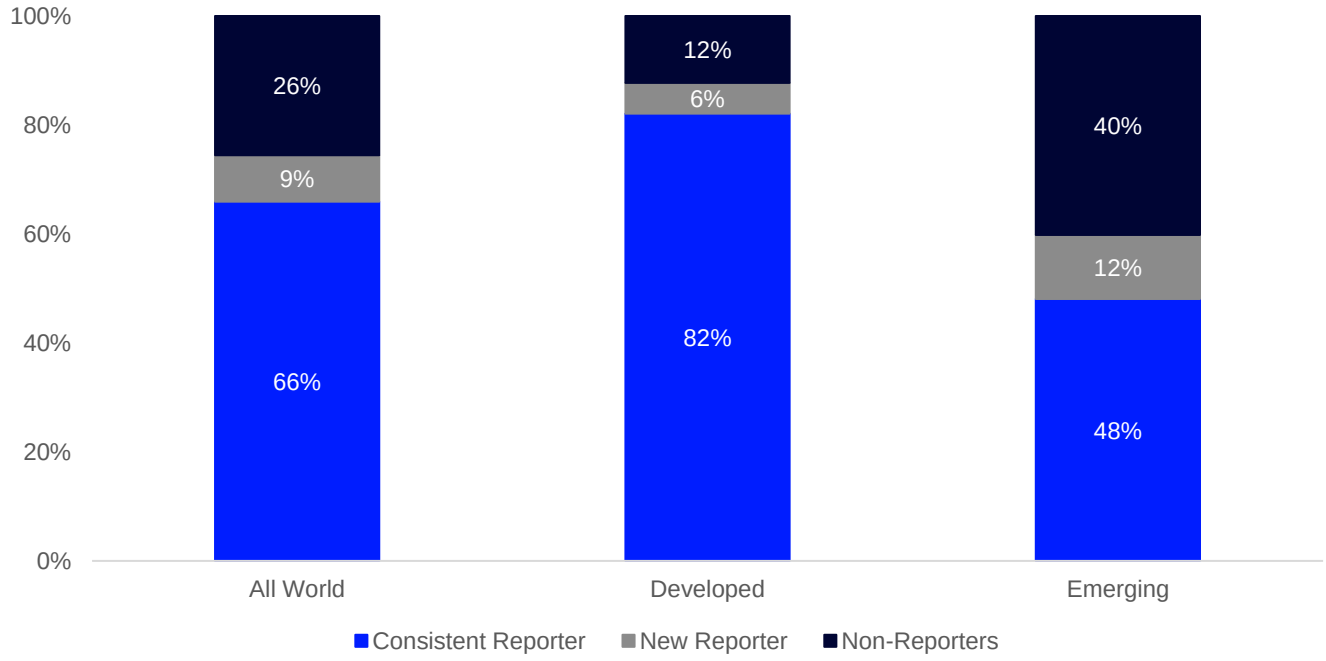
Appendix III. Additional charts

Figure 39: Decline in aggregate emission mostly driven by constituent churn
Contribution to the change of emissions due to churn



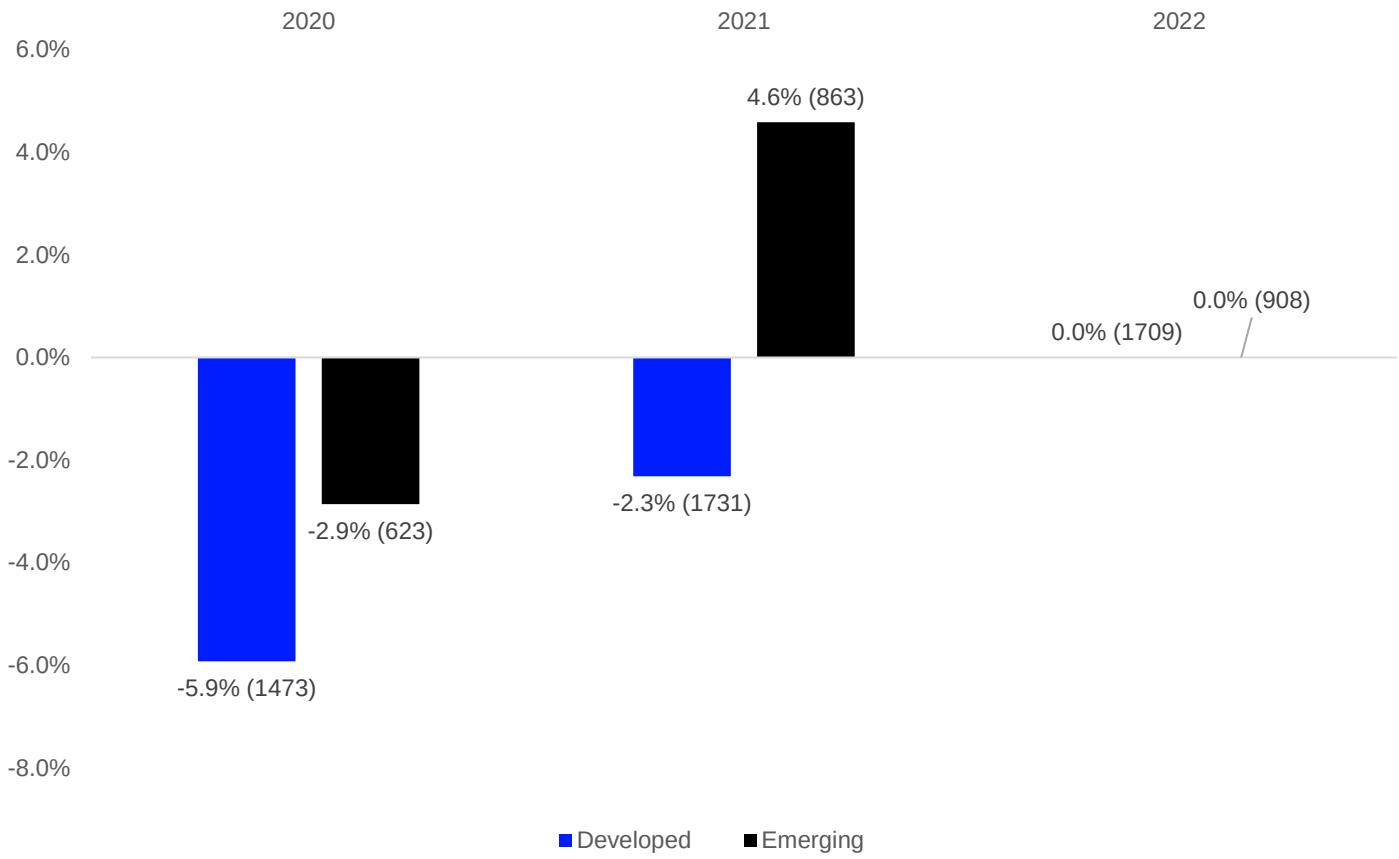
Source: LSEG, August 2024

Figure 40: Disclosure continues to improve
Proportion of disclosing All-World companies in 2022 by source of emissions



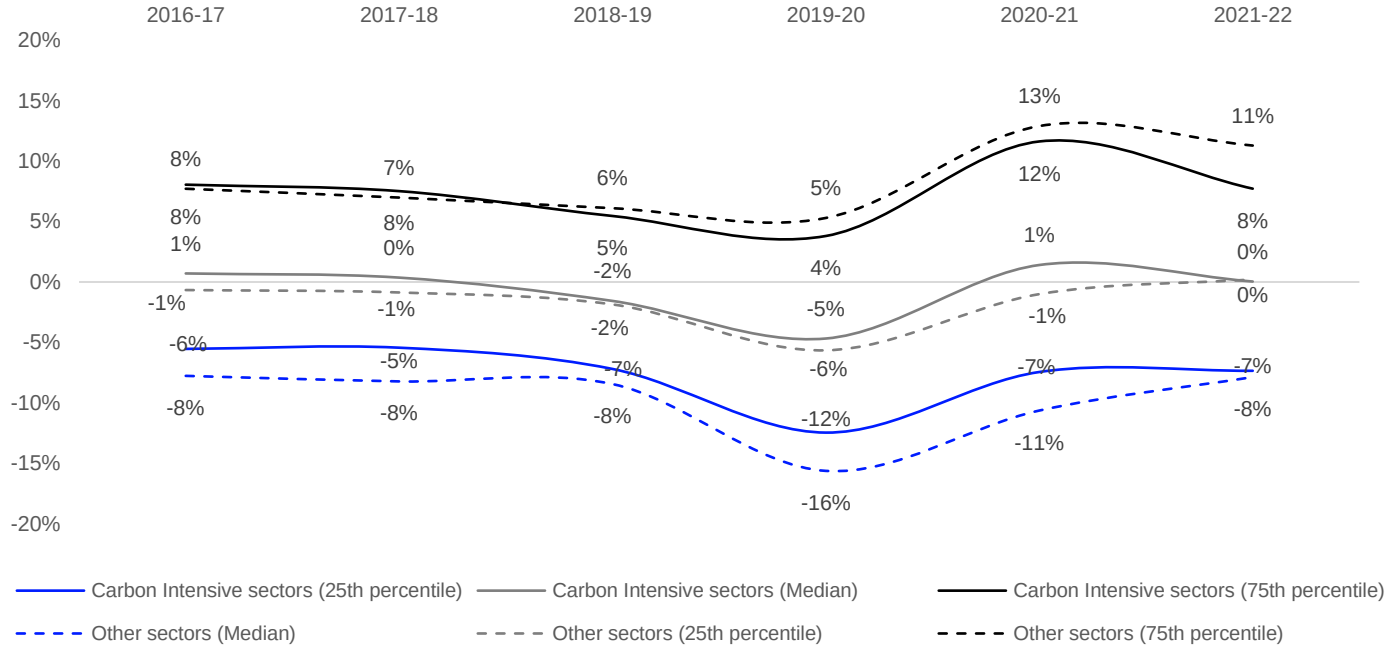
Source: LSEG, August 2024

Figure 41: Emerging and Developed consistent reporters are now witnessing aligning trends
Median change in reported emissions for consistently reporting companies by region



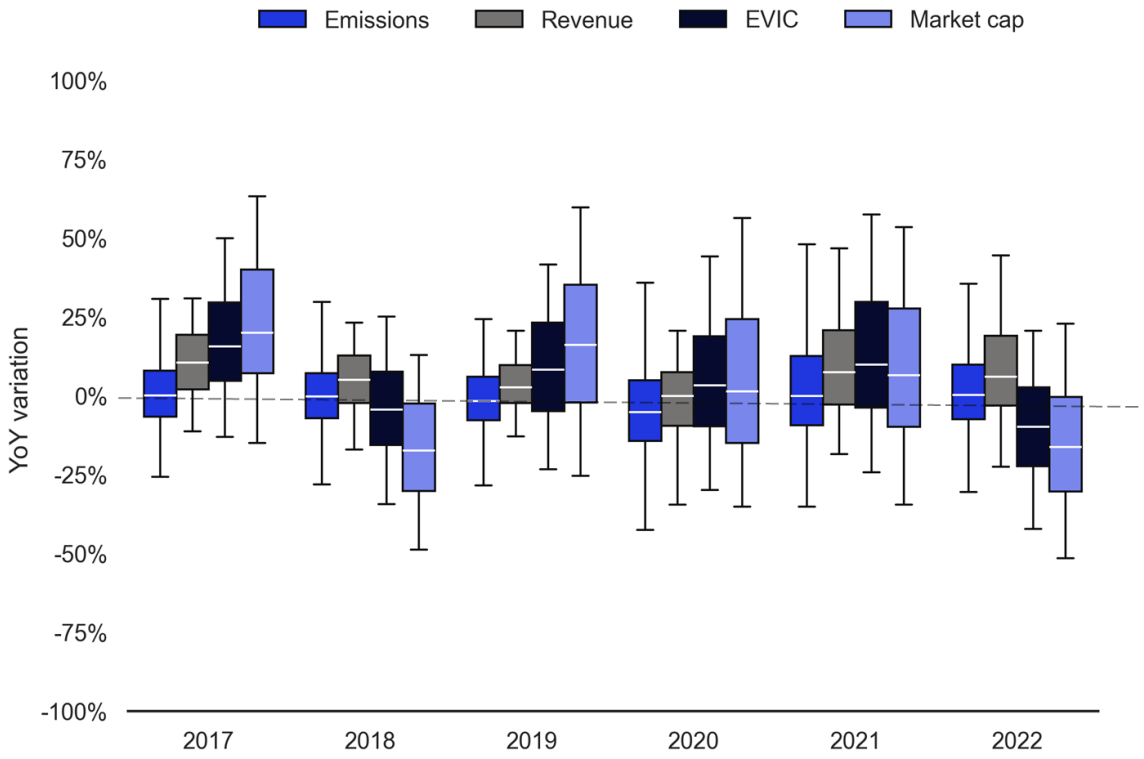
Source: LSEG, August 2024

Figure 42: Flat changes in reported emissions of both carbon and non-carbon intensive firm in 2022
Annual distribution of changes in reported emissions, carbon intensive vs other sectors



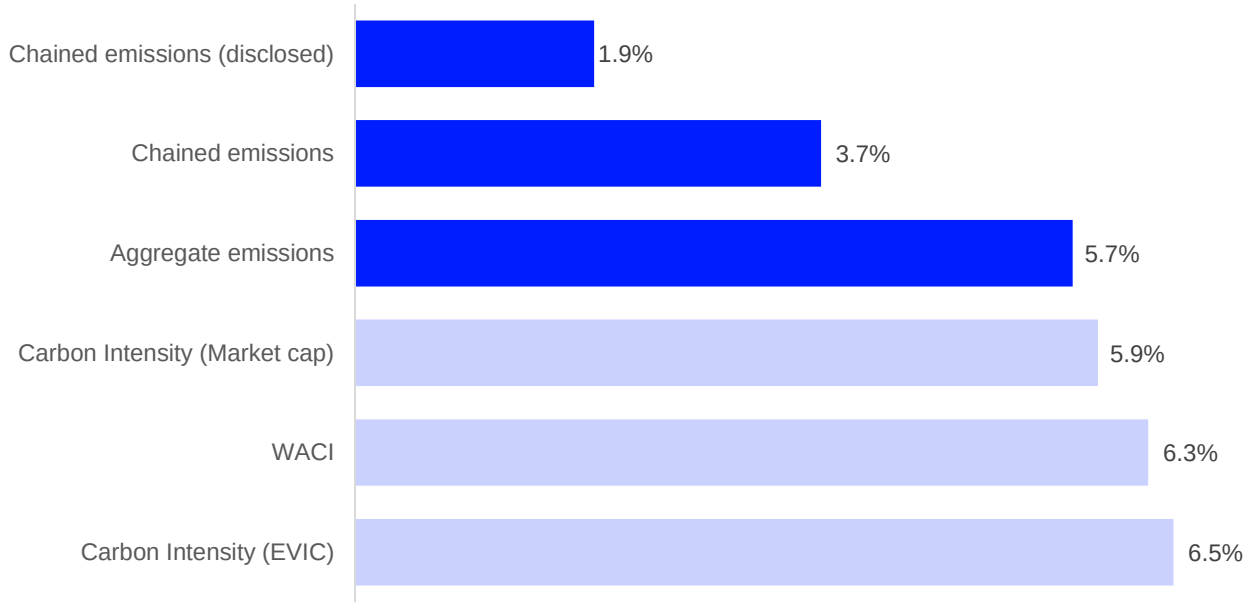
Source: LSEG, August 2024

Figure 43: Intensity normalisation factors more volatile than reported emissions
Distribution of yearly changes of normalisation factors



Source: LSEG, August 2024

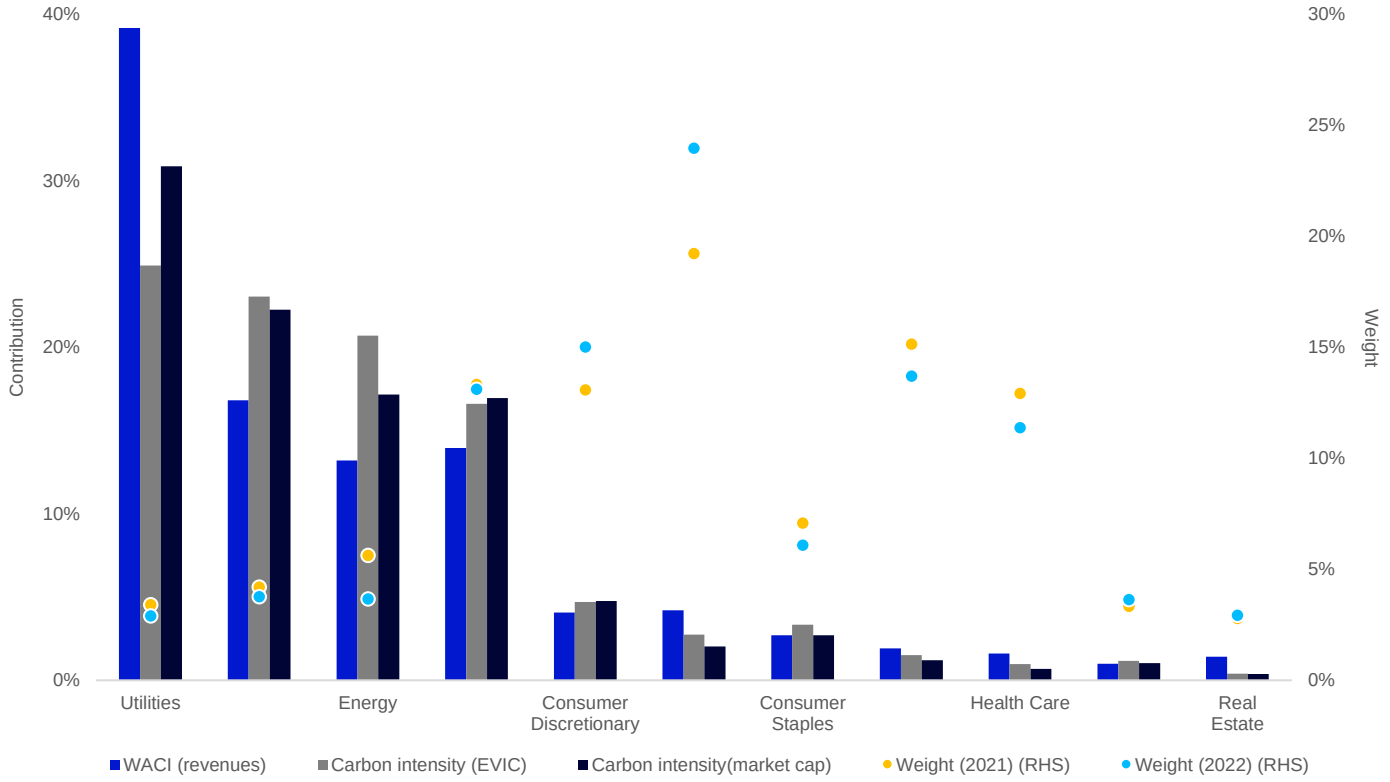
Figure 44: Marked annual volatility in index intensity metrics
Median-based volatility indicator for portfolio metrics, 2017 – 2022, equities



Source: LSEG, August 2024

Figure 45: What makes up a portfolio carbon intensity

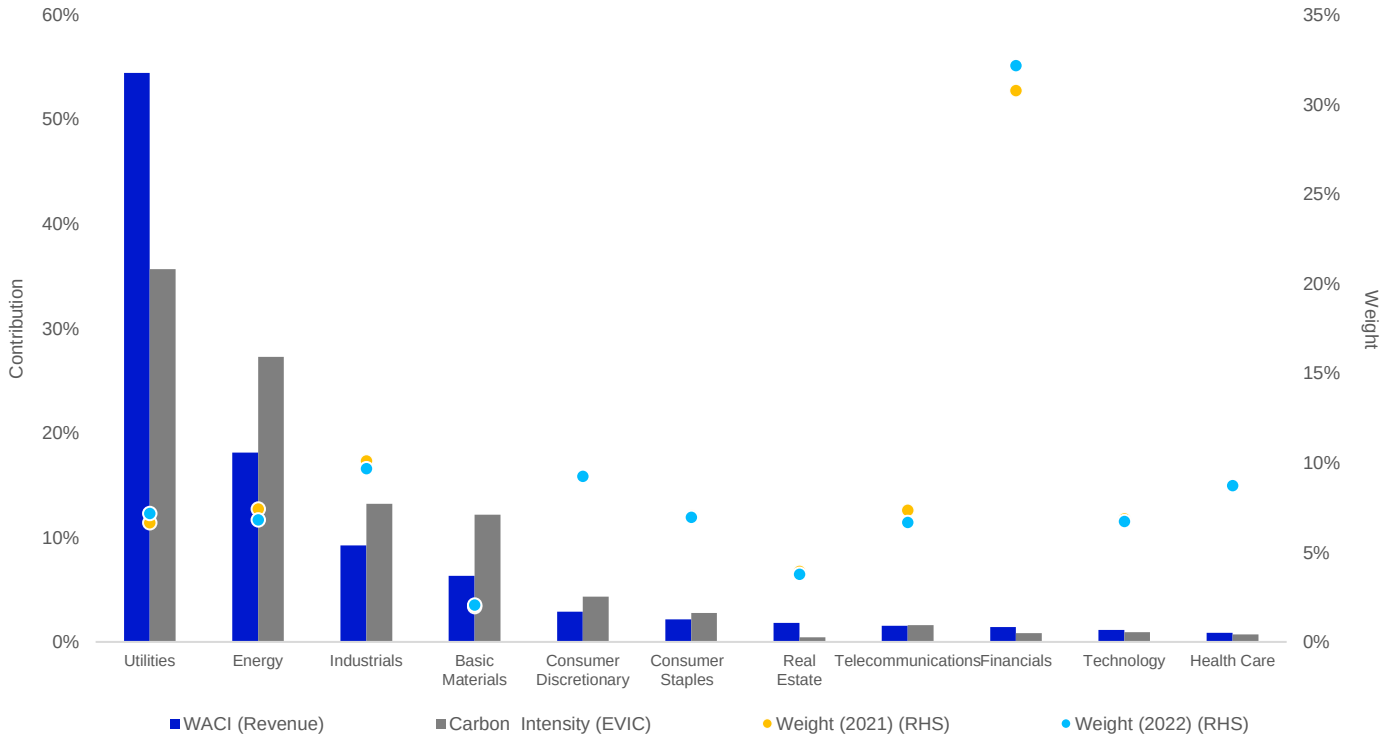
Proportion of contribution to Scope 1 and 2 intensity and index weight, by Industry, for 2022



Source: LSEG, August 2024

Figure 46: What makes up a fixed income portfolio carbon intensity

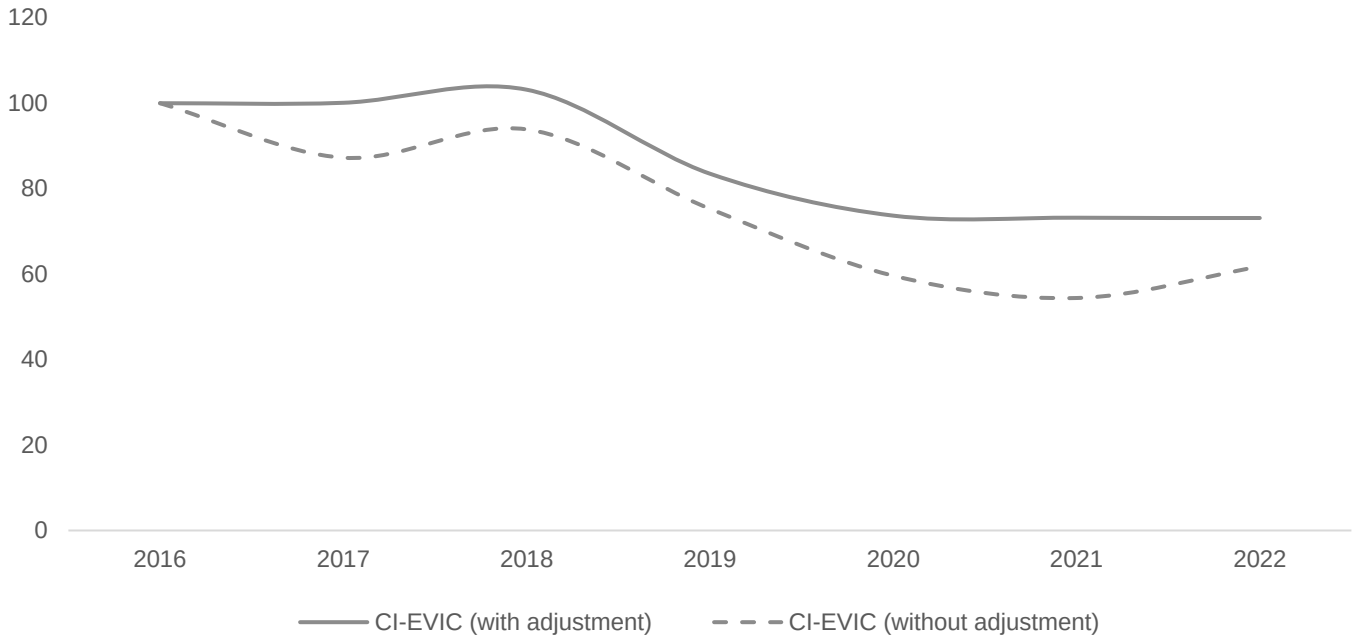
Proportion of contribution to Scope 1 and 2 intensity and index weight, by Industry, for 2022



Source: LSEG, August 2024

Figure 47: Carbon intensity, by EVIC

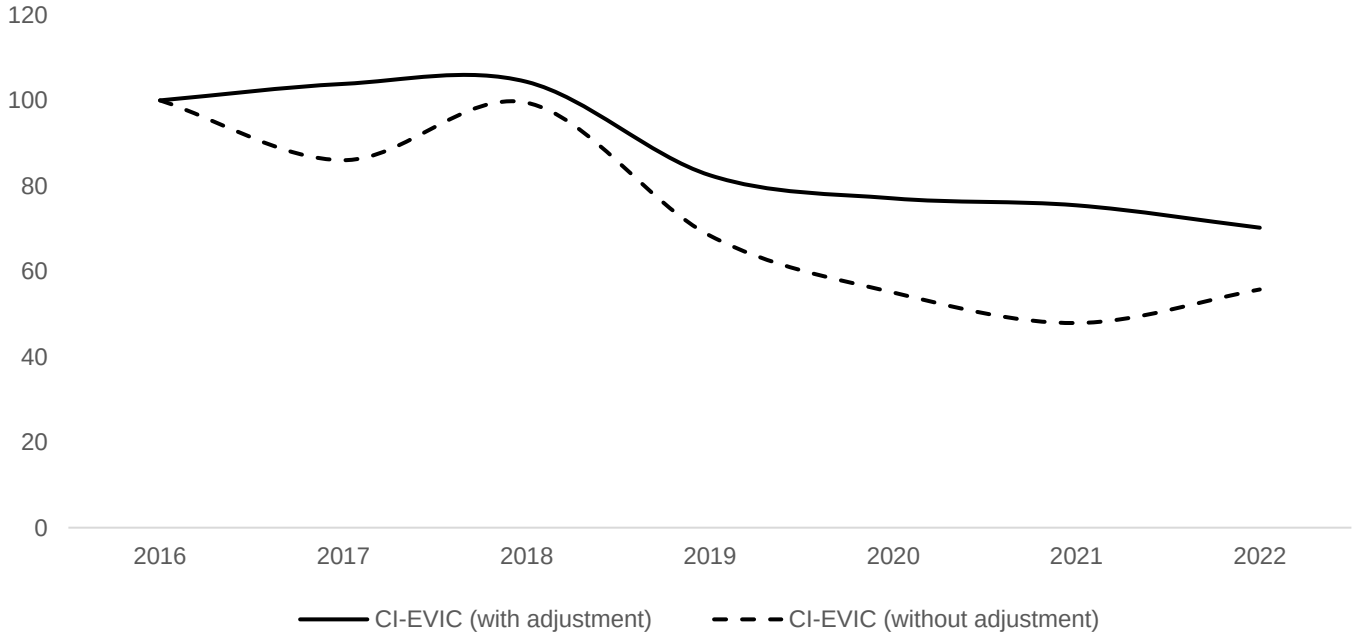
Scope 1 and 2 intensity by EVIC, FTSE All-World (2016=100)



Source: LSEG, August 2024

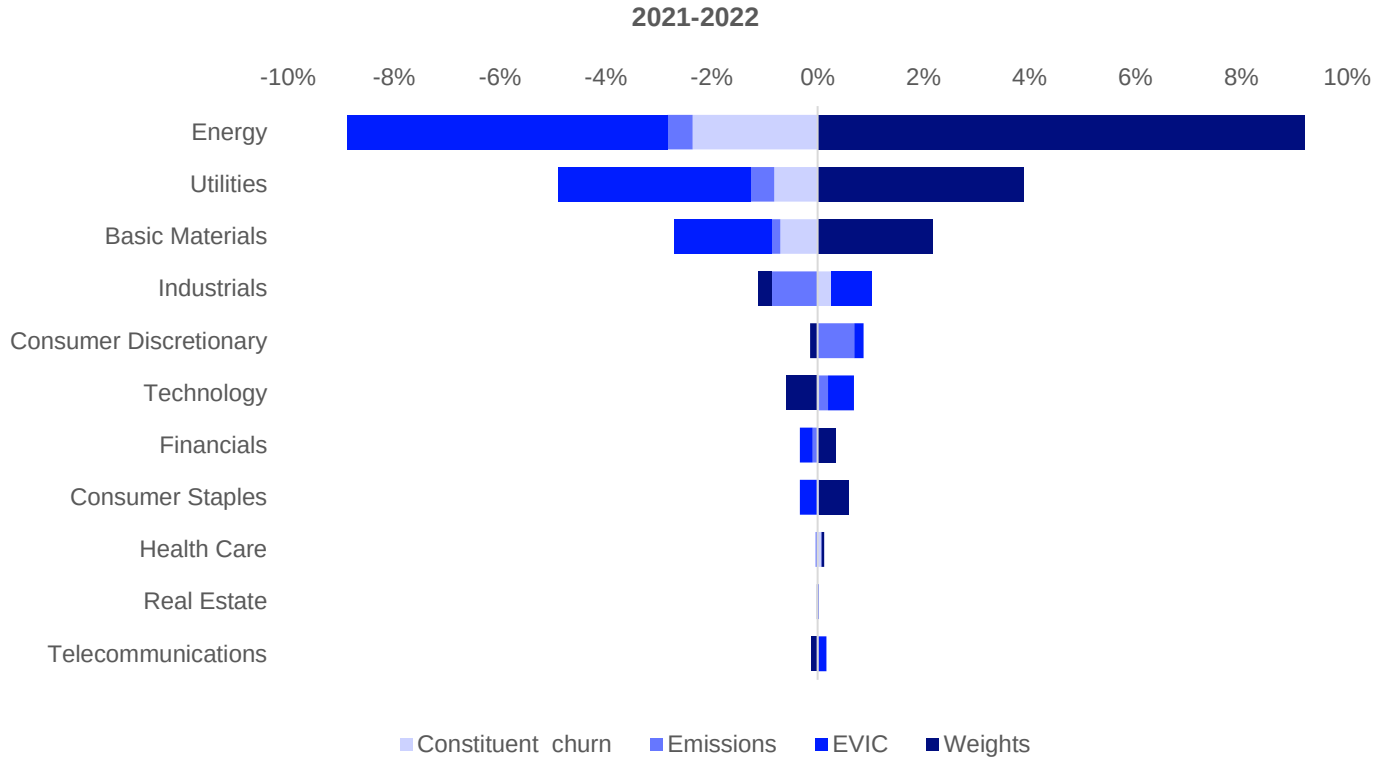
Figure 48: Carbon intensity, by market cap

Scope 1 and 2 intensity by market cap, FTSE All-World (2016=100)



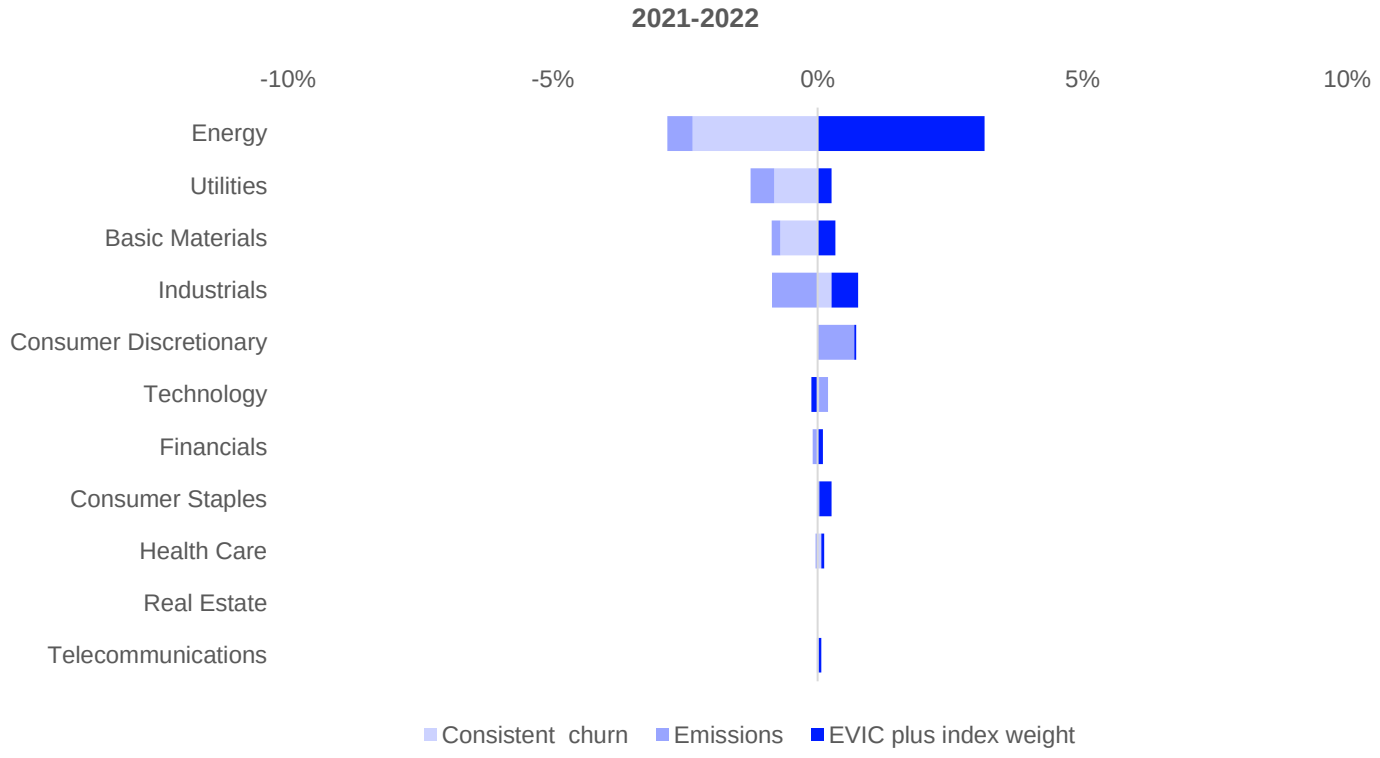
Source: LSEG, August 2024.

Figure 49: Weight and EVIC (*emissions in industrials) changes in high-carbon industries deliver highest contribution.
Sectoral attribution Carbon Intensity (EVIC) equities



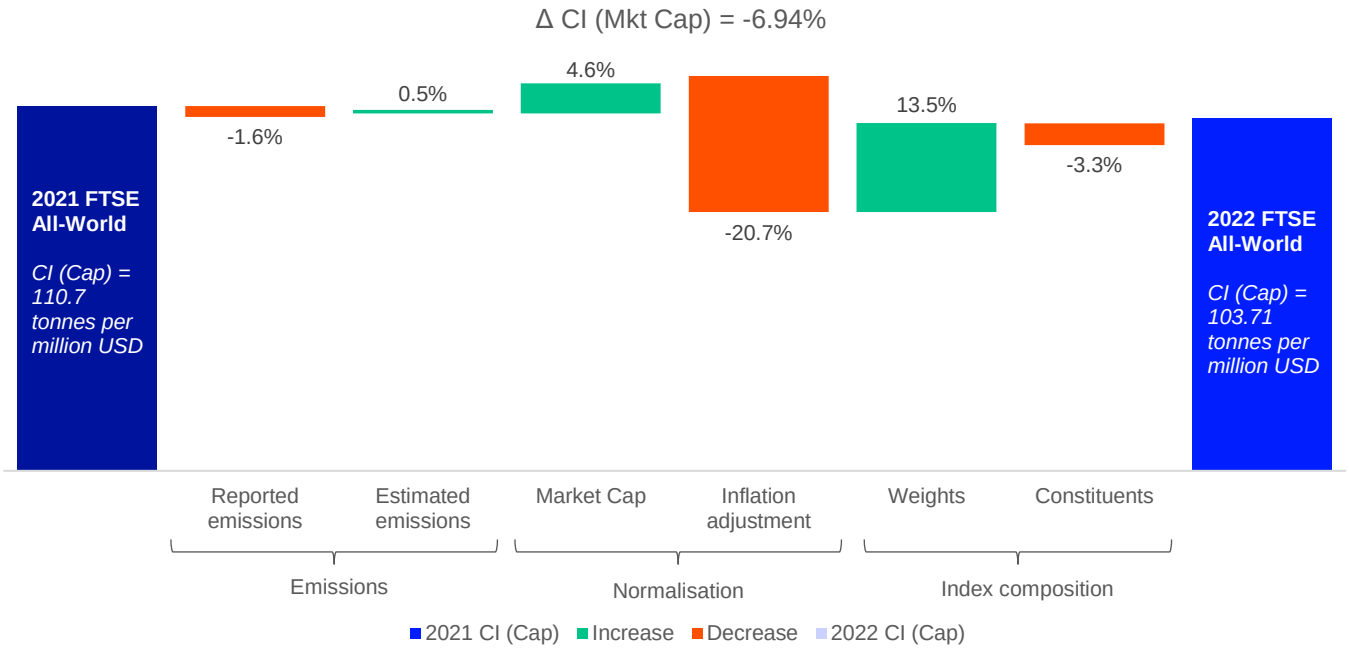
Source: LSEG, August 2024.

Figure 50: Weight + EVIC and constituent churn (*emissions in industrials) changes in high-carbon Industries deliver highest contribution
Sectoral attribution Carbon Intensity (EVIC) equities



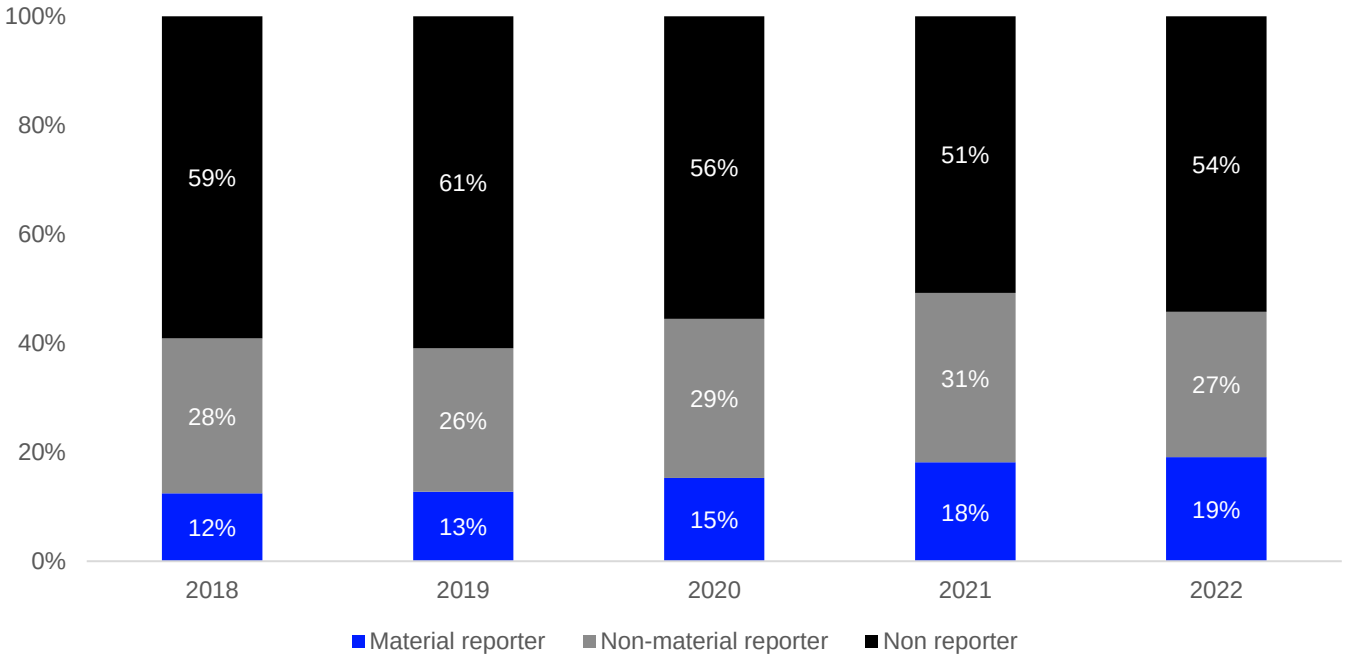
Source: LSEG, August 2024.

Figure 51: Disaggregating portfolio CI (Market Cap) changes for Scope 1 and 2
Contribution by category to the change of Carbon intensity (market cap) (2021-2022)



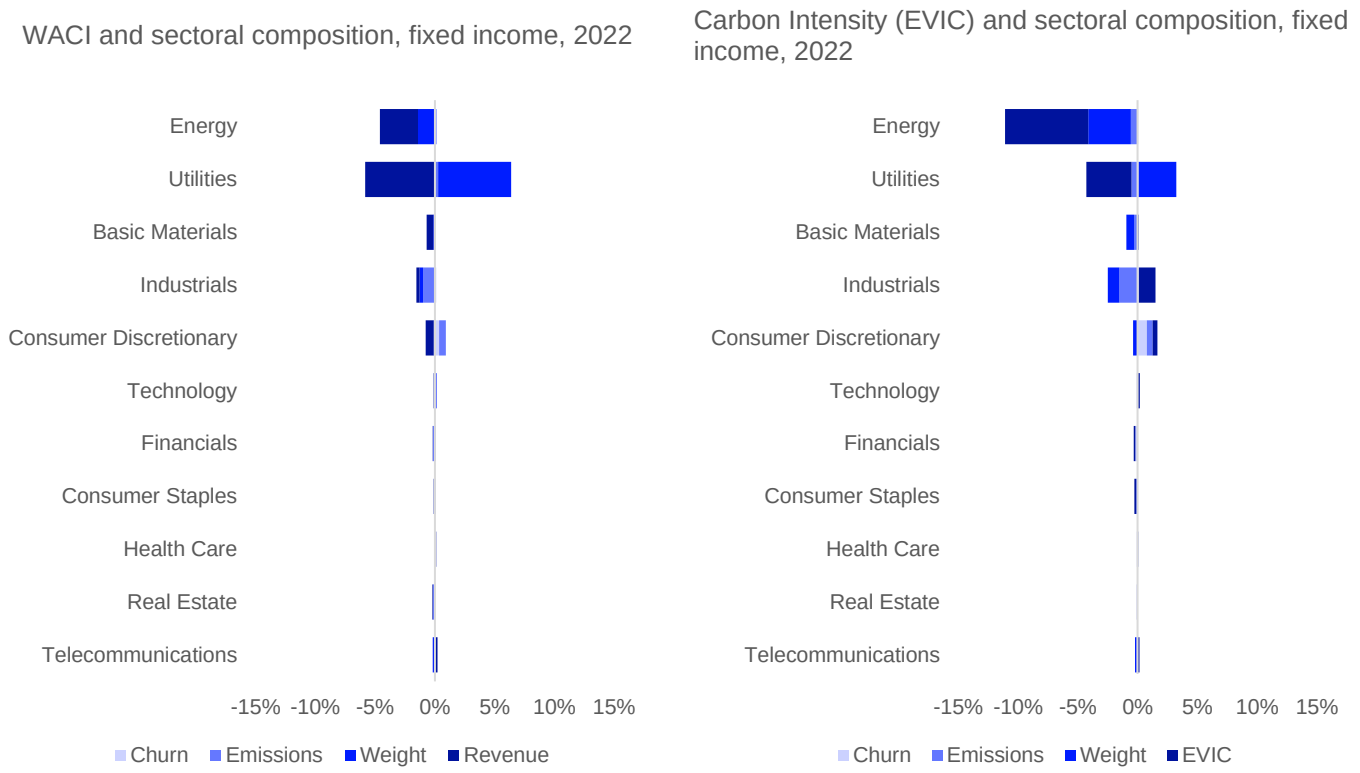
Source: LSEG, August 2024

Figure 52: Despite the improvement in material Scope 3 reporting, underreporting is still an issue
Scope 3 disclosure rate of All World constituents, 2018 – 2022



Source: LSEG, August 2024

Figure 53: Weight and revenues/EVIC changes in high-carbon Industries deliver highest contribution.



Source: LSEG, August 2024

Appendix IV. Contribution analysis

Contributions to change in WACI are calculated by taking the logarithmic change of individual factors (index weight, carbon emissions, revenues). The contribution to change in WACI from emissions ($CE_{k,t}$) between time **t** and **t-1** for a constituent **k**[62] with greater than 0 index weight **(**$W_{j,t}$, $W_{j,t-1}$**)** is given by:

$$CE_{k,t} = \frac{ln\left(\frac{E_{k,t}}{E_{k,t-1}}\right)}{ln\left(\frac{W_{k,t}}{W_{k,t-1}}\right) + ln\left(\frac{E_{k,t}}{E_{k,t-1}}\right) - ln\left(\frac{R_{k,t}}{R_{k,t-1}}\right)} * (W_{k,t}\frac{E_{k,t}}{R_{k,t}} - W_{j,t-1}\frac{E_{k,t-1}}{R_{k,t-1}})$$

Where:

- $CE_{k,t}$ is contribution to change in WACI from emissions from constituent k at time t,
- $E_{j,t}$ is yearly carbon emissions,
- $R_{k,t}$is annual revenues,
- $W_{k,t}$ is index weight.[63]

Relevant inflation factors (or in the calculation of Financed Emissions, portfolio size) can be added as additional explicit factors. Individual factors can be further disaggregated once the initial contribution has been apportioned:

- Changes due to emissions can be assigned based on the source of the emission data
- Changes due to changing constituents can likewise be distinguished from general changes due to changing weights.

[62] In fixed income, constituent k represents a unique bond issuer, and W_k represents the sum of weights of all bonds from issuer k in a given year.

[63] In the unlikely event that changes in individual factors exactly cancel (change of contribution to WACI is 0), the relative contributions of individual factors will also be 0.

Appendix V. Data Sources

1.1 FINANCIAL DATA

Company-level financial data are sourced from WorldScope as inputs into carbon intensity calculations and estimation strategies. This includes the following metrics:

– EVIC

– Revenue

– Segment revenues (see business segment taxonomy, below)

Revenue estimates for FY2022 were retrieved from I/B/E/S, while Market Capitalisation was sourced from FTSE Russell.

1.2 REPORTED EMISSIONS

Scope 1,2, and 3 emissions data are sourced from the LSEG Data & Analytics Climate database. Full details on these, including details around estimation models can be seen here: Company Estimated Greenhouse Gases (GHG) Emissions (lseg.com)

In practice, calculations are based on both reported and estimated data sourced from the LSEG Hierarchical Multi-model framework (see details below). Due to lags in the publishing of company reported carbon numbers, we are currently utilising fiscal year 2022 as our most recent disclosed sample.

1.3 INFLATION ADJUSTMENTS

Inflation adjustments have been made in carbon exposure metrics wherever necessary to eliminate the bias of inflation in trend analysis for carbon intensity. Currency and asset inflation adjustments have been made to revenues and EVIC, respectively.

Values for carbon intensity have been adjusted against the US GDP deflator as retrieved from the World Economic Outlook database of the International Monetary Fund.[64] Company-specific revenue data are converted to USD according to the local, point-in-time exchange rate.

The EVIC adjustment factor is calculated by dividing the average EVIC of the equity universe by that of the average EVIC of 2021, as suggested by the Climate Benchmark Handbook of the EU Commission.[65] A more recent submission has proposed that an asset value inflation factor should be calculated for each individual constituent, based on the changes in its market value since the initial period of analysis.[66]

1.4 REGIONAL CLASSIFICATION INFORMATION

We assign companies to a region to create peer groups for several estimation strategies - the Sector Median and Regression strategies. For this, we largely align our regional definitions with those used within the FTSE Global Equity Index Series,[67] but combine classifications for Japan, China, Asia Pacific ex China ex Japan to create a larger dataset of reported data for these regions where disclosure is often more limited.

[64] World Economic Outlook. https://www.imf.org/en/Publications/WEO, IMF, accessed 01/23/2022.

[65] EU Handbook of Paris-Aligned Benchmarks, accessed on 22nd August 2022.

[66] Please see: EU Commission (2022) EU Commission Platform Recommendations on Data and Usability

Figure 54: Regional aggregation

Developed Europe	Emerging Europe	North America	Latin America	Developed Asia Pacific	Emerging Asia, Middle East & Africa (ex China)	China
Austria	Czechia	Canada	Brazil	Australia	India	China
Belgium	Greece	United States	Chile	Hong Kong	Indonesia	
Denmark	Hungary		Colombia	Japan	Malaysia	
Finland	Russia		Mexico	Korea	Pakistan	
France	Turkey		Peru	New Zealand	Philippines	
Germany				Singapore	Taiwan	
Ireland					Thailand	
Italy					UAE	
Netherlands					Egypt	
Norway					Israel	
Poland					Qatar	
Portugal					Saudi Arabia	
Spain					South Africa	
Sweden						
Switzerland						
United Kingdom						

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