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# Implications of reducing the carbon footprint of equity factor portfolios

Raj Shah
Senior Factor and Quantitative Strategist

Fadi Zaher
Head of Index Solutions, EMEA

**The Index Solutions team**
Silvio Corgiat Mecio
Fanggang (Royce) Yan
Jason Lee
Ayah Habboub
Archimidis Fotopoulos

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## Executive summary

We observe that highly diversified global style and factor portfolios could help preserve factor characteristics and risk/return profiles after reducing carbon intensity.

Therefore, investors could achieve alignment with their net-zero or carbon intensity reduction commitments without necessarily compromising their return objectives.

However, there are nuances that investors need to be aware of when aiming to gain factor exposure while reducing carbon intensity:

1. **Methodology choice of integrating decarbonisation**
   There are trade-offs in decarbonising via exclusions or tilting.

2. **Sector effect**
   Some sectors are more carbon intensive than others, and some factors tend to have large overweight positions to these sectors.

3. **Regional effect**
   Certain regions show sectoral skews. For example, the UK stock market is heavily skewed to energy and financial companies. Therefore, achieving both high factor potency and reduced carbon intensity could be challenging in such regions.

4. **Security effect**
   At single security level, the tug-of-war between climate and style factor may have a bigger influence on the overall climate and factor style dynamics. There are many companies that have high factor scores but also high carbon intensities. For more concentrated portfolios, achieving both high factor potency and reduced carbon intensity could be challenging.

This paper aims to show how the effects described above influence outcomes in decarbonised factor portfolios.

Factor based and style investing strategies represent an alternative rules-based approach to traditional index investing such as market capitalisation indices. Popular factors include value, quality, momentum, low volatility and size. Today, these strategies represent over $1.5 trillion[1] in assets under management.

At the same time, we have seen increasing demand for decarbonised investment strategies as investors adopt net-zero commitments.

In this paper, we'll explore how decarbonisation could influence the performance and risk profiles of traditional equity factor strategies. As our research will demonstrate, the way a portfolio is decarbonised matters.

### Factor investing and decarbonisation

Factor-based investing, or smart beta strategies, involve targeting specific drivers of return across asset classes. Traditional factors include value (undervalued stocks), quality (e.g. profitable companies), momentum (trending stocks), size (e.g. smaller companies) and low risk (less volatile stocks). For more details on L&G's factor definitions, see our capability webpage. We have also written blogs on each of the factors we target in our investment strategies (see box on the next page).

> "We have seen increasing demand for decarbonised investment strategies as investors adopt net-zero commitments"

1. Source: Bloomberg, L.P., data through 12/31/2023.

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**The Low-Volatility factor**

- A very human origin story
- Not-so-standard deviation
- Winning by losing less (until recently)

**Quality explained**

- Is profit a prophet?
- A price worth paying?
- Putting theory into practice

**Price momentum**

- The curious case of market inertia
- The trend is your friend, until it isn't

**Value meets vision**

- The rise of innovation capital
- Performance testing a modified factor strategy

To meaningfully incorporate environmental criteria – specifically reduced carbon intensity – into equity factor strategies, we must first evaluate how this influences each factor. Integrating environmental criteria without controls can shift the composition of, for example, a value portfolio by allocating less to the energy sector or other carbon-intensive sectors. This could alter the exposure to the individual style factor, and the risk-return profile.

Assessing the sensitivities of each factor to decarbonisation objectives helps us to understand the main trade-offs when constructing multi-factor equity strategies with decarbonisation objectives.

We decarbonise single factor equity strategies using two methods – exclusions and tilting[2]. Descriptions of these methods are provided below. We then explore the effect of decarbonising single factor equity strategies considering three dimensions:

1. **Factor potency**
   Does decarbonising lead to a reduction in factor potency, i.e. a reduced exposure to the relevant factor?

2. **Decarbonising effect on portfolio**
   To what extent do the original portfolio's constituents and weights change when decarbonising?

3. **Change in risk profile**
   What is the impact on the active risk profile? This can be assessed by comparing the tracking error of the decarbonised equity factor portfolio to the original portfolio.

### The carbon footprint of factor portfolios

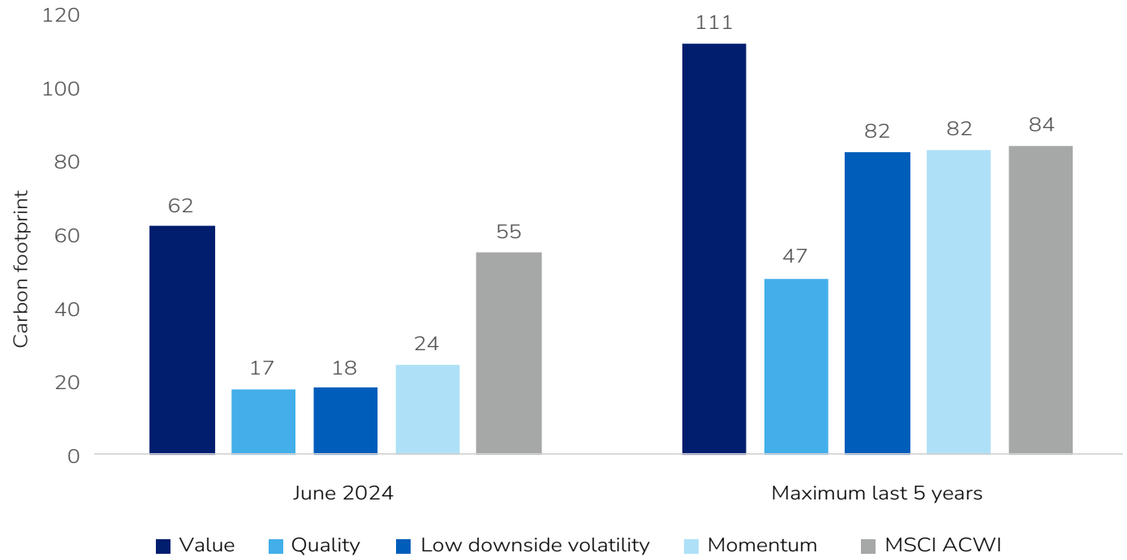
Before assessing how factor strategies can be decarbonised, we analysed the typical carbon footprint of the most popular equity factor portfolios.

Using a global benchmark representing developed and emerging markets as the starting universe and our factor scoring methodology, we construct top tercile equity portfolios for each factor (Value, Quality, Low Volatility and Momentum) on a quarterly basis over 10 years (March 2014 – June 2024). These are portfolios that exhibit high active exposures to the relevant factor. Figure 1 below shows the carbon footprint as of June 2024 as well as the maximum value over the past five years.

**Based on the four equity factors shown below, we observe that:**

- The Value factor tends to be the most carbon intensive.
- The Quality factor tends to be least carbon intensive.
- Price-driven factors such as Low Volatility and Momentum exhibit wider carbon footprint ranges.

Fig 1. Carbon footprint – latest values and maximum over past five years




Source: L&G, MSCI, ISS, Refinitiv. 30 June 2019-30 June 2024

2. Another method that can be used is optimisation, but we generally prefer to use tilting with an optimisation overlay to preserve the proportionality between climate scores and final allocations.

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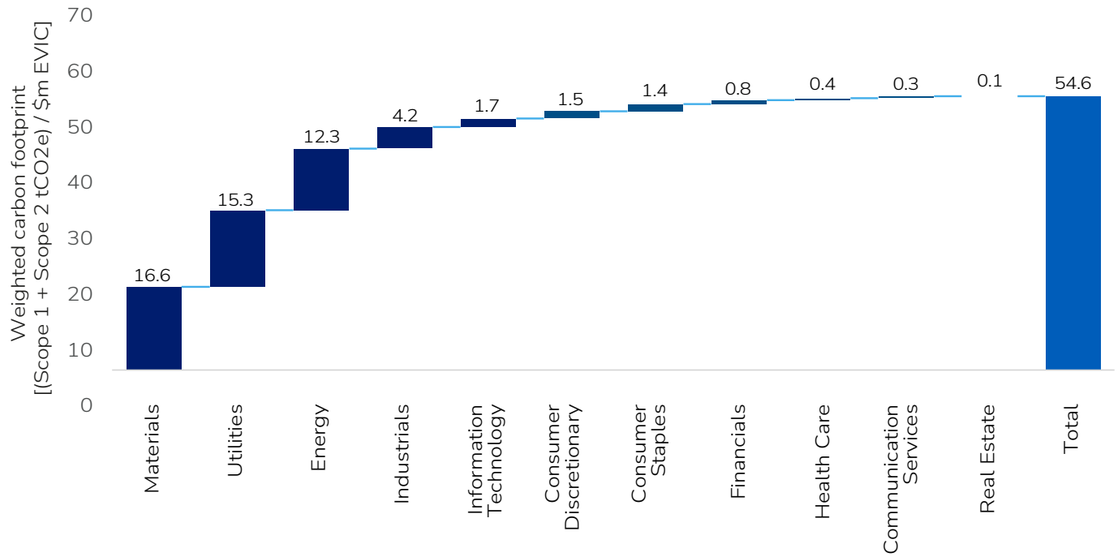
Fig 2. Market cap benchmark sector contribution to total weighted average carbon intensity as of June 2024.




Source: L&G, MSCI, ISS, Refinitiv. As of June 2024

When decarbonising a portfolio versus a market cap index, sector distributions are an important consideration. It is well known that three or four sectors contribute the majority of (weighted) emissions – Materials, Utilities and Energy, with Industrials following to a lesser extent (see Figure 2 above). Overweight positions in any of these sectors would generally tend to increase the weighted average carbon intensity.

It is helpful to look at the sector distribution of the top tercile factor portfolios in order to have a sense of the starting point before applying decarbonisation.

Generally speaking, it may be more challenging to reduce carbon intensity and preserve factor exposure for portfolios with overweight positions in high-carbon sectors. The reverse is also true: an underweight position to high-carbon sectors suggests that carbon intensity can be reduced relatively easily while preserving factor exposure.

Figure 3 (opposite) shows the sector over- and underweights of the top tercile factor portfolios versus the MSCI AC World Index as of June 2024.

For top tercile factor portfolios, we typically observe that:

- **Value** tends to have a significant overweight to Financials and Energy, and a significant underweight to Information Technology.
- **Quality** tends to have a significant overweight to Information Technology.
- **Low downside volatility** tends to be overweight defensive sectors such as Consumer Staples and Healthcare.
- Price-driven factors (**low downside volatility** and **momentum**) can display larger dispersion of sector allocations over time. See figure A2 in the Appendix, which shows large dispersion of sector weights over 10 years from 2014-2024.

We summarise (opposite) the level of intervention each factor strategy would need to decarbonise versus a market cap benchmark.

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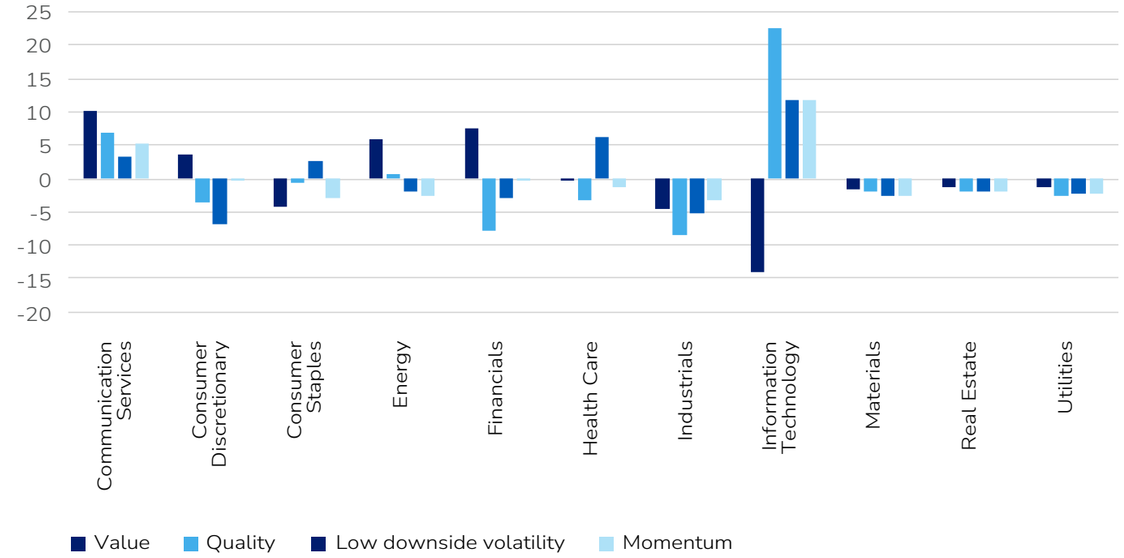
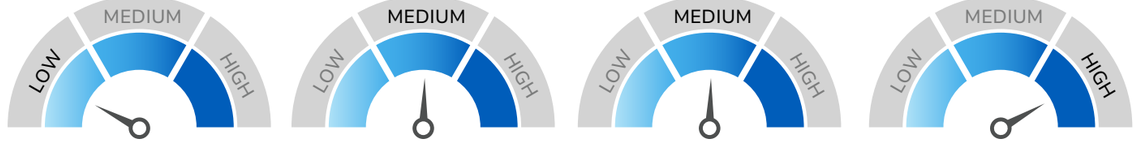
Fig 3. Sector distribution of top tercile factor portfolios




Source: L&G, MSCI. As of June 2024




## Quality

Carbon footprint is lowest

## Low Volatility

Sector rotation drives level of intervention required

## Momentum

Sector rotation drives level of intervention required

## Value

Carbon footprint is highest

Source: L&G. 31 March 2014-30 June 2024

> "When decarbonising a portfolio versus a market cap index, sector distributions are an important consideration"

# Methods to decarbonise portfolios

Decarbonising the top tercile factor portfolios can generally be done in two ways:

### Exclusions

The highest market cap-weighted emitters are excluded progressively until the decarbonisation target is reached. This method tends to penalise only the most energy-intensive sectors.

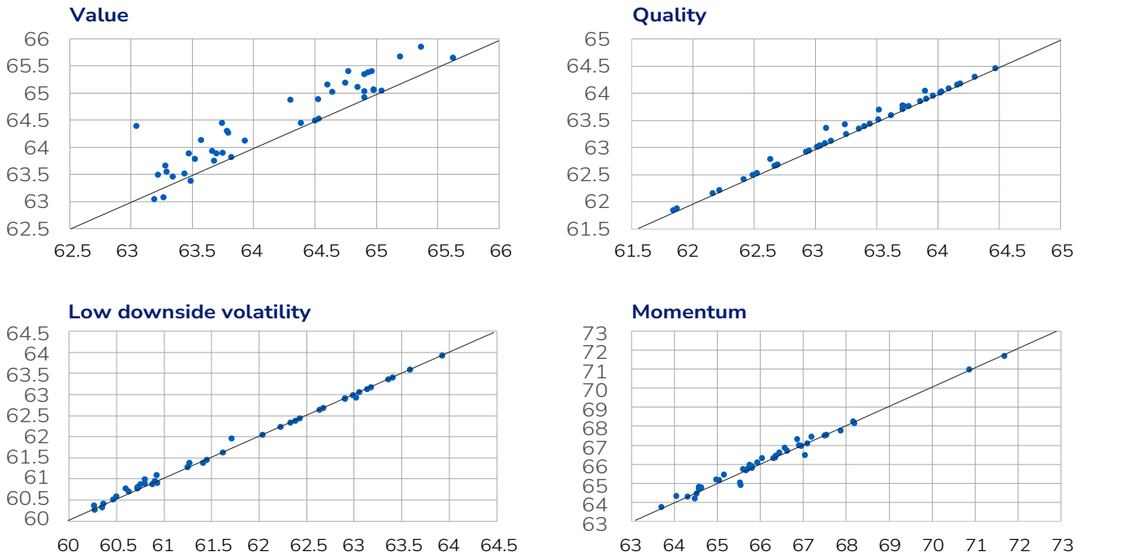
### Tilting

The security market weights are tilted towards lower emitters and away from higher emitters until the decarbonisation target is reached. By also applying sector constraints, it is possible to limit extreme sector deviation from the original factor portfolio. This method also tends to avoid outright exclusions.

After decarbonising each of the factor portfolios using the two methods described above at each time point, we then study the impact on factor potency (i.e. how strongly the factor characteristics remain represented), sector deviations and risk profile.

In this study, we target a 50% decarbonisation target versus a broad market capitalisation index[3] and +/-5% relative sector weight constraint for the tilting approach. Exclusions are applied progressively, and the portfolio is re-weighted until decarbonisation target is achieved.

Fig 4a. Factor scores before and after decarbonising via exclusions




Source: L&G, MSCI, ISS, Refinitiv. Quarterly periods from March 2014- June 2024

3. Source: We use the MSCI All Country World Index constituents as the starting universe

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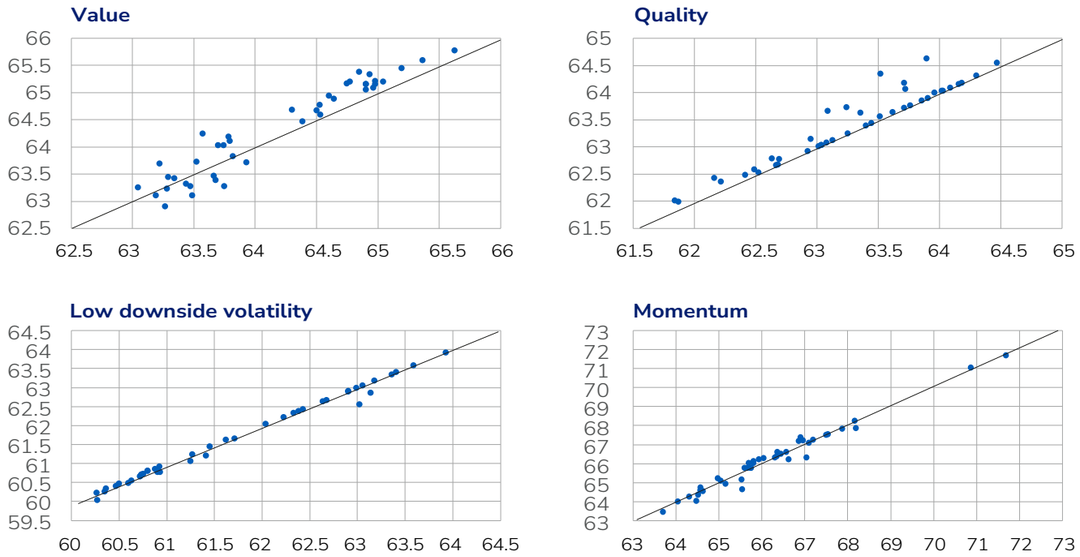
> “Decarbonising top tercile factor portfolios to achieve 50% of the market cap benchmark carbon footprint would involve somewhat altering the top tercile value portfolio, either via exclusions or via tilting.”

Fig 4b. Factor scores before and after decarbonising via tilting




Source: L&G, MSCI, ISS, Refinitiv. Quarterly periods from March 2014- June 2024

### Global top tercile portfolios – factor potency

Decarbonising top tercile factor portfolios to achieve 50% of the market cap benchmark carbon footprint would involve somewhat altering the top tercile value portfolio, either via exclusions or via tilting. Figure 4a shows the factor scores before and after exclusions are applied for each of the four factors; Figure 4b above, contrasts factor scores after the decarbonisation is applied via tilting instead; Figure 4c overleaf shows sector differences using the two alternative approaches for the Value factor as an example.

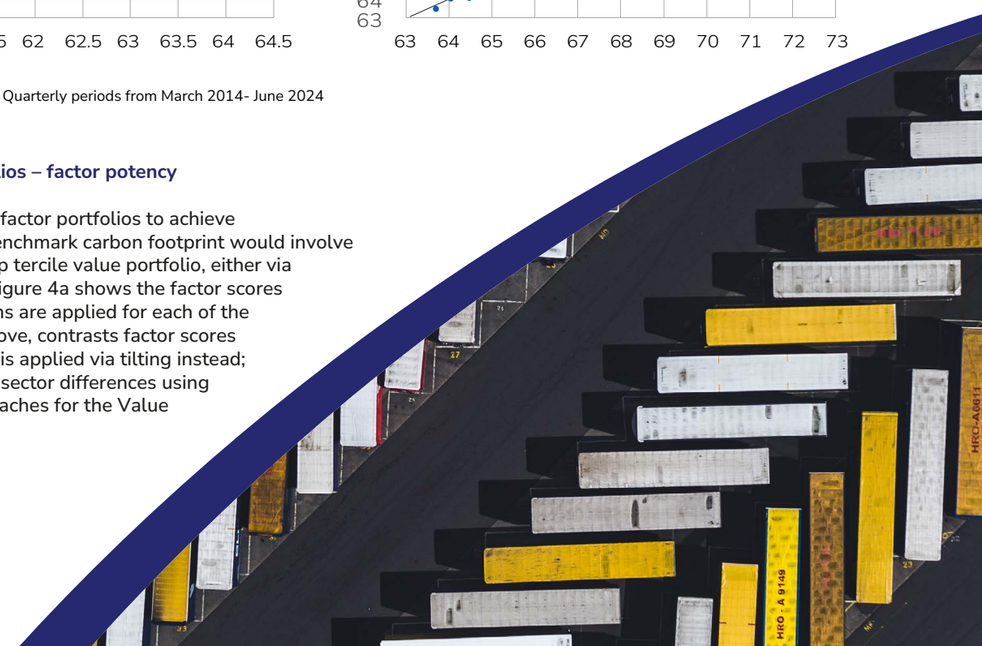
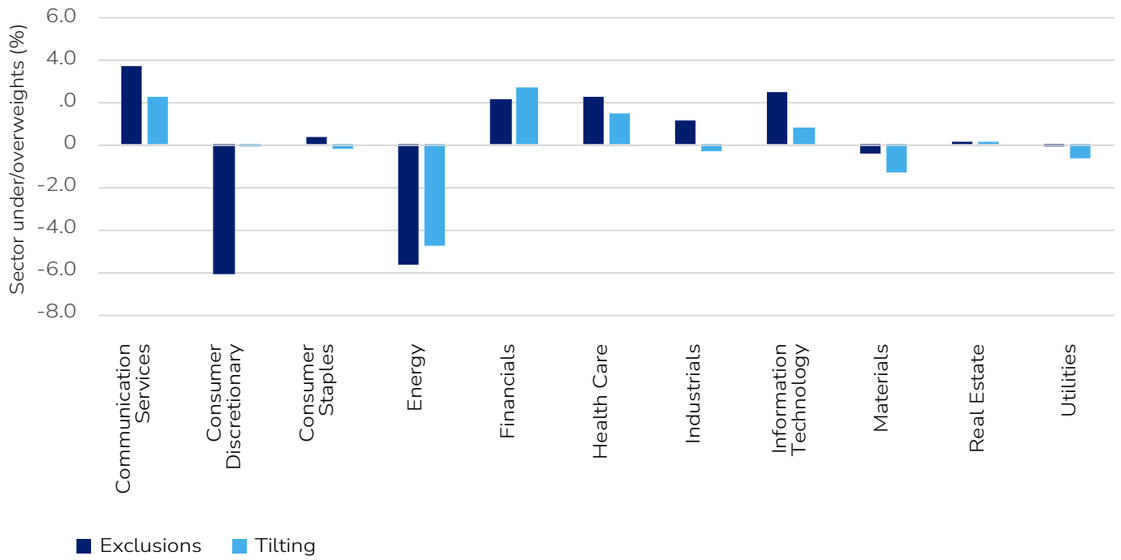


Fig 4c. Sector over and underweights after decarbonising value factor




Source: L&G, MSCI. As of June 2024

**For a global top tercile factor portfolio, looking at figures 4a-c (above), we observe the following:**

Both exclusions and tilting methods succeed in achieving the decarbonisation target of 50% versus the market cap benchmark across all time periods.

Factor potency is largely unaffected after decarbonising via exclusions or tilting i.e. factor scores (characteristics) remain largely similar after decarbonisation. Value factor scores increase marginally after decarbonising via exclusions.

However, at a sector level, we observe relatively large differences in some sector exposures for the Value factor (note that the other three factors were already 'decarbonised' versus the market cap benchmark as of June 2024).

The exclusion method largely affects the Energy sector (and, surprisingly, the Consumer Discretionary sector) with a large underweight position as expected, without affecting the other sector allocations significantly.

The tilting method affects the Energy sector marginally less than the exclusion method, but also exhibits a large underweight position to the Materials sector.

Having considered the factor potency and change in portfolio composition after decarbonisation, we next consider what effect decarbonisation has on the risk profile of the factor portfolios.

### Global top tercile portfolios – risk/return profile

In a nutshell, we do not observe significant differences in risk-return characteristics when decarbonising the factors. Table 1 opposite shows the returns, volatility and ex-post tracking error versus the original top tercile factor strategy from 2014 – 2024.

Table 1. Risk/return characteristics of decarbonising factors with exclusions and tilting

| Factor | | Top tercile portfolio | | |
|---|---|---|---|---|
| | | Original | Exclusions | Tilting |
| Value | Return (% p.a.) | 9.6 | 9.8 | 9.8 |
| | Volatility % p.a.) | 15.8 | 16.0 | 15.8 |
| | Tracking error vs original top tercile (ex-post % p.a.) | - | 1.1 | 0.9 |
| Quality | Return (% p.a.) | 12.4 | 12.5 | 12.7 |
| | Volatility % p.a.) | 15.7 | 15.7 | 15.7 |
| | Tracking error vs original top tercile (ex-post % p.a.) | - | 0.2 | 0.4 |
| Low volatility | Return (% p.a.) | 10.4 | 10.8 | 10.7 |
| | Volatility % p.a.) | 13.3 | 13.1 | 13.2 |
| | Tracking error vs original top tercile (ex-post % p.a.) | - | 0.5 | 0.5 |
| Momentum | Return (% p.a.) | 11.3 | 11.3 | 11.5 |
| | Volatility % p.a.) | 15.4 | 15.5 | 15.6 |
| | Tracking error vs original top tercile (ex-post % p.a.) | - | 0.7 | 0.8 |

31 March 2014-30 September 2024. Source: L&G, FactSet

Value is the most affected, with tracking error of c.1% for the decarbonised portfolios versus the original top tercile portfolios. Quality, Low Volatility and Momentum are somewhat less affected. Quality's general overweight to lower emitting sectors means that the top tercile portfolios are already decarbonised at most time periods. Low Volatility and Momentum are driven by price and sector rotations, which dictate the level of decarbonisation required.

### From diversified to less diversified portfolios

We have observed that there are no significant effects when decarbonising a global top tercile value portfolio in terms of risk and return characteristics. We also note that highly diversified global portfolios are adequately diversified, so the impact of decarbonisation can be mute.

We also construct regional top tercile factor portfolios for the six regions in a similar fashion as the global top tercile portfolios. However, when considering individual regions, we observe that tracking error between the top tercile portfolios versus the decarbonised versions generally increases for most regions across all factors. This is primarily due to a lower number of securities used to construct these portfolios.

> "We have observed that there are no significant effects when decarbonising a global top tercile value portfolio in terms of risk and return characteristics"

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The table below summarises the ex-post tracking error observed between the original top tercile portfolios and the two decarbonised versions for the Value factor. We observe large deviations between the original top tercile portfolio and the decarbonised variants especially in UK, Asia Pacific ex-Japan and emerging markets. The results in the table also suggest that applying exclusions in some regions may be a less disruptive method of decarbonising factor portfolios, as seen by the lower tracking error versus decarbonising via tilting.

Therefore, as factor portfolios become more concentrated with fewer stocks, it becomes more difficult to maintain factor potency and the risk and return profile of the original top tercile factor while reducing carbon intensity.

**Table 2. Tracking error of decarbonised portfolios**

| Ex-post tracking error statistics | Top tercile Value | |
|---|---|---|
| | Exclusions | Tilting |
| North America | 1.2 | 1.1 |
| Emerging Markets | 2.4 | 3.9 |
| Europe ex UK | 0.9 | 0.8 |
| Japan | 0.7 | 1.4 |
| UK | 4.8 | 4.0* |
| Asia Pacific ex Japan | 2.8 | 4.1 |

* For most time periods tilting is unable to achieve the decarbonisation targets within the sector constraints set for the strategy.
Source: L&G, FactSet. 31 March 2014-30 September 2024.

### The tug-of-war at security level

There are many companies that exhibit strong factor characteristics but also exhibit high carbon intensities – these companies would therefore tend to be underweighted when decarbonising. This is quite common when stocks fall systemically in the high-emitting sectors, pushing many stocks into Value territory. This happened to many diversified Value factor strategies when energy stocks fell in 2018 (see Figure 5) causing various challenges for portfolios with decarbonisation objectives. While not visible from a tracking error (i.e. performance deviation) perspective in global diversified portfolios, the tug-of-war is often more prominent in concentrated portfolios (in weight and number of securities).

> “As factor portfolios become more concentrated with fewer stocks, it becomes more difficult to maintain factor potency and the risk and return profile of the original top tercile factor strategy while reducing carbon intensity”

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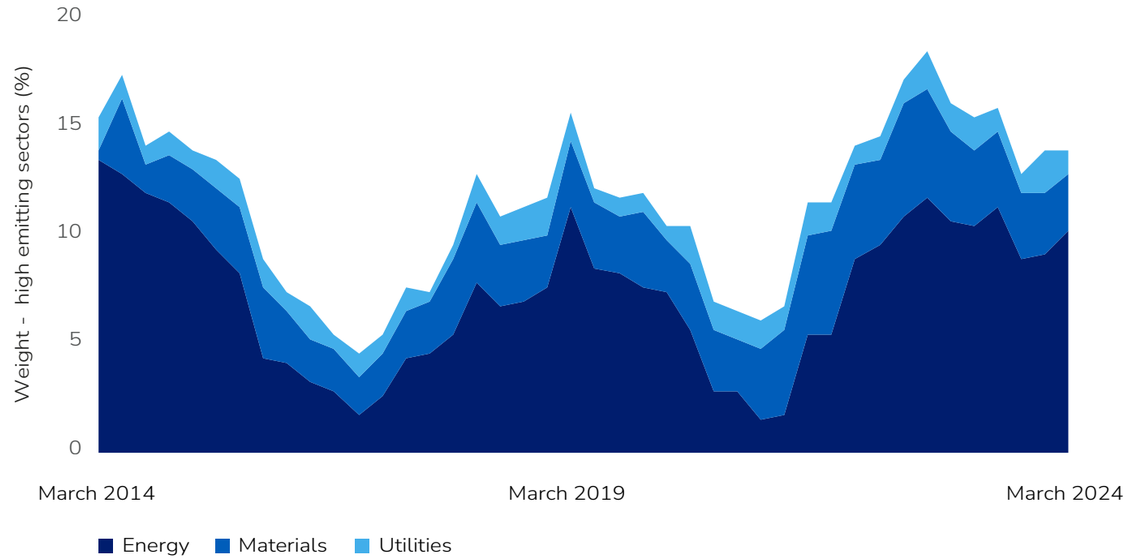
Fig 5. Portfolio weights in high-emitting sectors – Top tercile Value




Source: L&G, MSCI, ISS, Refinitiv . 31 March 2014-30-June 2024

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## Conclusions

Based on empirical analysis, we observe that highly diversified global style and factor portfolios can preserve factor characteristics and risk/return profiles after reducing carbon intensity. Therefore, investors can achieve alignment with their net-zero or carbon intensity reduction commitments without compromising their return objectives.

However, for less diversified portfolios, it may become more difficult to maintain factor potency and the risk and return profile. Therefore, it is very important for investors to carefully assess the portfolio design choices when attempting to reduce the carbon intensities of factor portfolios.

We list below the other main observations and conclusions based on the analysis described in this paper:

### Carbon intensity varies between factors

The Value factor tends to be the most carbon intensive, while the Quality factor tends to be least carbon intensive. Price-driven factors such as Low Volatility and Momentum exhibit wider carbon footprint ranges.

### Portfolio design choices matter

Exclusions may lead to more extreme sector deviations versus tilting. It is important for investors to consider the design choices applied, especially any constraints applied to during portfolio construction.

### Concentrated portfolios pose a greater challenge

There are many companies that have high factor scores but also high carbon intensities. We see this in certain regional portfolios that are naturally less diversified e.g. UK.

### Carbon intensity tends to be cyclical, depending on the macro environment

For example, we observe that the Value factor does not consistently exhibit large overweight positions to energy-intensive sectors (Figure 5).

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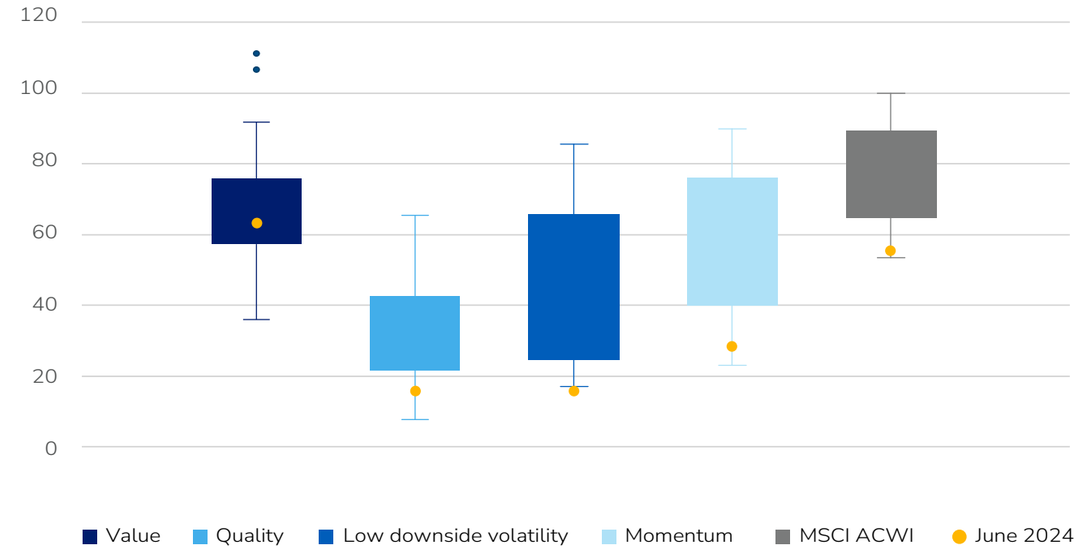
> “Investors can achieve alignment with their net-zero or carbon intensity reduction commitments without compromising their return objectives”

# Appendix

Figure A1 shows the distribution of the portfolio weighted average carbon footprint[4] for each top tercile factor portfolio compared to MSCI ACWI over 10 years. In the illustration, the 'boxes' contain interquartile range and medians of the historical carbon footprint's averages, while the 'whiskers' show the maximum and minimum (excluding outliers) over time.

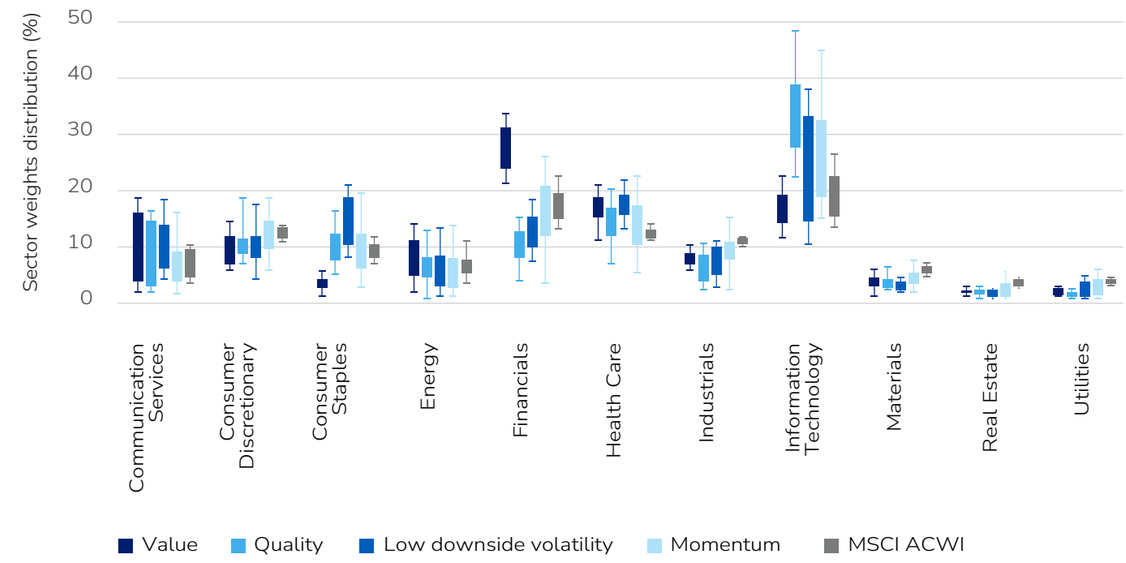
Figure A2 shows the sector distribution of the top tercile factor portfolios constructed quarterly over 10 years to June 2024.

**A1. Carbon footprint distribution over 10 years**




Source: L&G, MSCI, Refinitiv, ISS. 31 March 2014-30 June 2024

**A2. Sector distribution of top tercile factor portfolios**




Source: L&G, MSCI. 31 March 2014-30 June 2024

4. Carbon footprint is defined as (Scope 1 + Scope 2 tCO2e) / $m EVIC



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