Portfolio Insight

The Role of Carbon in a Portfolio

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Introduction

Climate change has the potential to shatter the status quo in the investing world. Extreme weather events driven by climate change may upturn assumptions about the risk-return profiles of traditional assets based on past performance. Actions taken to mitigate climate change could also entail new business costs, once again changing market assumptions on risk and returns. Tools to hedge against these risks may prove valuable to investors and help diversify their portfolios.

In this Portfolio Insight, we:

1. Explore the role of carbon markets as a hedge against climate risk.
2. Present a framework to answer, ‘what is the optimal weight an investor should allocate to carbon allowance futures in a portfolio’?

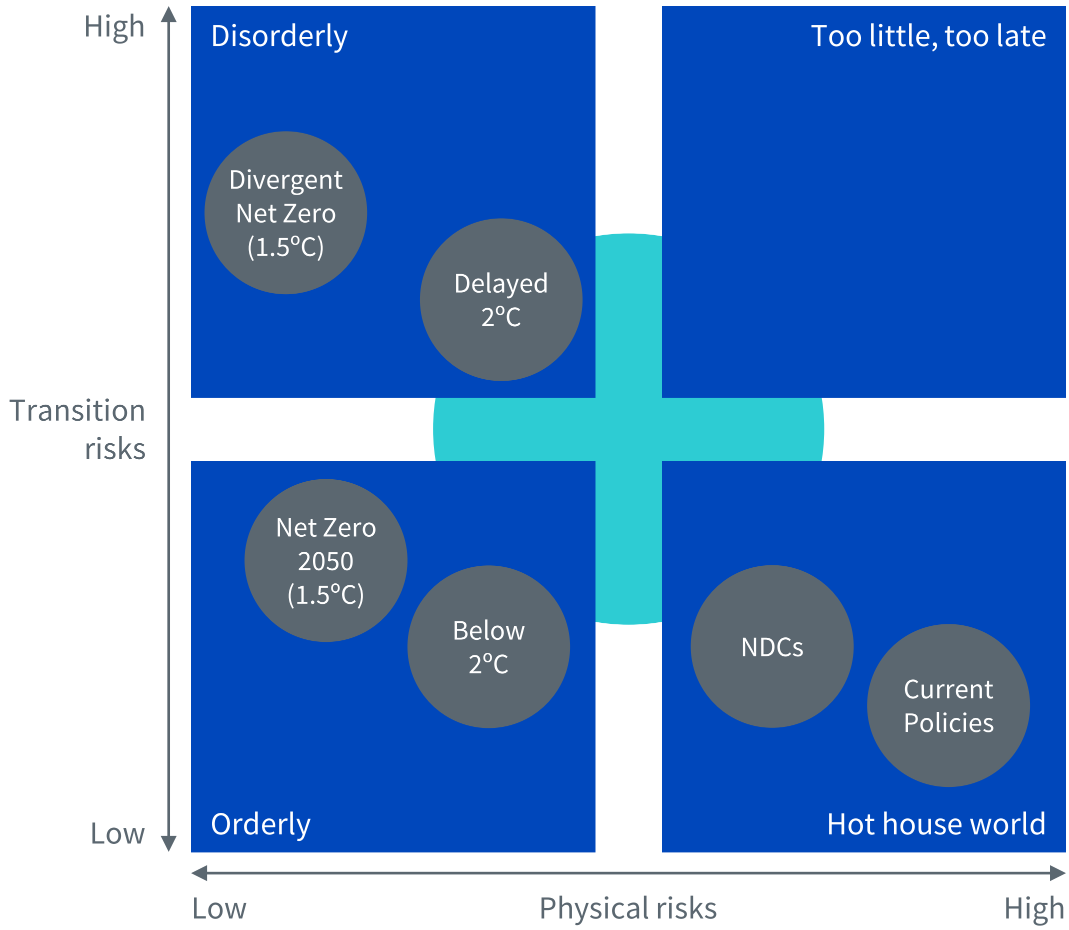
Part 1: Climate risk and carbon markets

Climate change poses many risks to businesses and investments. The Network for Greening the Financial System (NGFS) – the central bank sponsored organisation responsible for translating the Intergovernmental Panel on Climate Change (IPCC) climate risks to financial sector risks - does a great job of summarising these risks along two key dimensions:

1. **Physical risks:** these relate to the effects of global warming on physical capital, human health and productivity, and agriculture. These risks are often associated with extreme weather such as floods, droughts, cyclones and wildfires which inhibit the ability to conduct business and may impair assets associated with those businesses.
2. **Transition risks:** these relate to action taken to reduce emissions to reach net zero greenhouse gas (GHG) emissions. Transition risks will affect the profitability of businesses and households, creating financial risks for lenders and investors.

The framework acknowledges the trade-off between the two risks: not transitioning in a timely and coordinated fashion increases physical risks; rapidly implementing policies to reduce physical risks increases transition risks and calls into question the sustainability of those policies. The trade-off is summarised in the infographic below.

Figure 1: NGFS scenarios framework



Source: NFGS, 2023.

Hot house world

There is broad recognition that **Current Policies** around the world aren't bold enough to put us on a sustainable climate path. Nor will **Nationally Determined Contributions (NDCs)**[1] get us there. Physical risks remain abundant in these scenarios: what the NGFS terms a 'hot house world'.

Disorderly

Should policymakers make a sudden U-turn towards an accelerated policy path, we risk a 'disorderly' transition, known as the **Delayed 2°C** scenario[2]. A more ambitious climate policy framework that lacks coordination **(Divergent Net Zero (1.5°C[3]))** will reduce physical risks but heighten transition risks. These two scenarios are grouped together in a 'disorderly' bucket.

Orderly

The NGFS believes a coordinated **Below 2°C** scenario or a coordinated **Net Zero 2050 (1.5°C)** offer the best chances to reduce both physical and transition risks. These fall into the 'orderly' bucket.

Role of carbon as a hedging tool

We believe that managing both physical risks and transition risks will be vital to maintain macroeconomic and financial market stability. However, it's largely the role of policymakers to keep the world on track to deliver an orderly outcome. While households, investors and businesses may help support the efforts to get there, uncoordinated individual efforts are unlikely to be successful. We believe that investors could benefit from using carbon markets as a means for hedging against worst-case outcomes.

Carbon pricing is an instrument that captures the external costs of GHG emissions—the costs of emissions that the public pays for, such as damage to crops, healthcare costs from heat waves and droughts, and loss of property from flooding and sea level rise—and ties them to their sources through a price. There is a growing consensus among both governments and businesses on the fundamental role of carbon pricing in the transition to a decarbonised economy.

Carbon markets are designed to reduce GHG emissions. There are a variety of carbon pricing mechanisms. One of the most relevant to investors is the Cap-and-Trade, Emissions Trading Systems (see Putting a price on Carbon: Market-based solutions to decarbonisation). The price of allowances traded in these emissions trading systems are likely to rise as policymakers step up their efforts to meet climate goals by tightening the market. Prices may also rise if polluters fail to reduce their GHG emissions and thus need to buy more allowances than policymakers had anticipated.

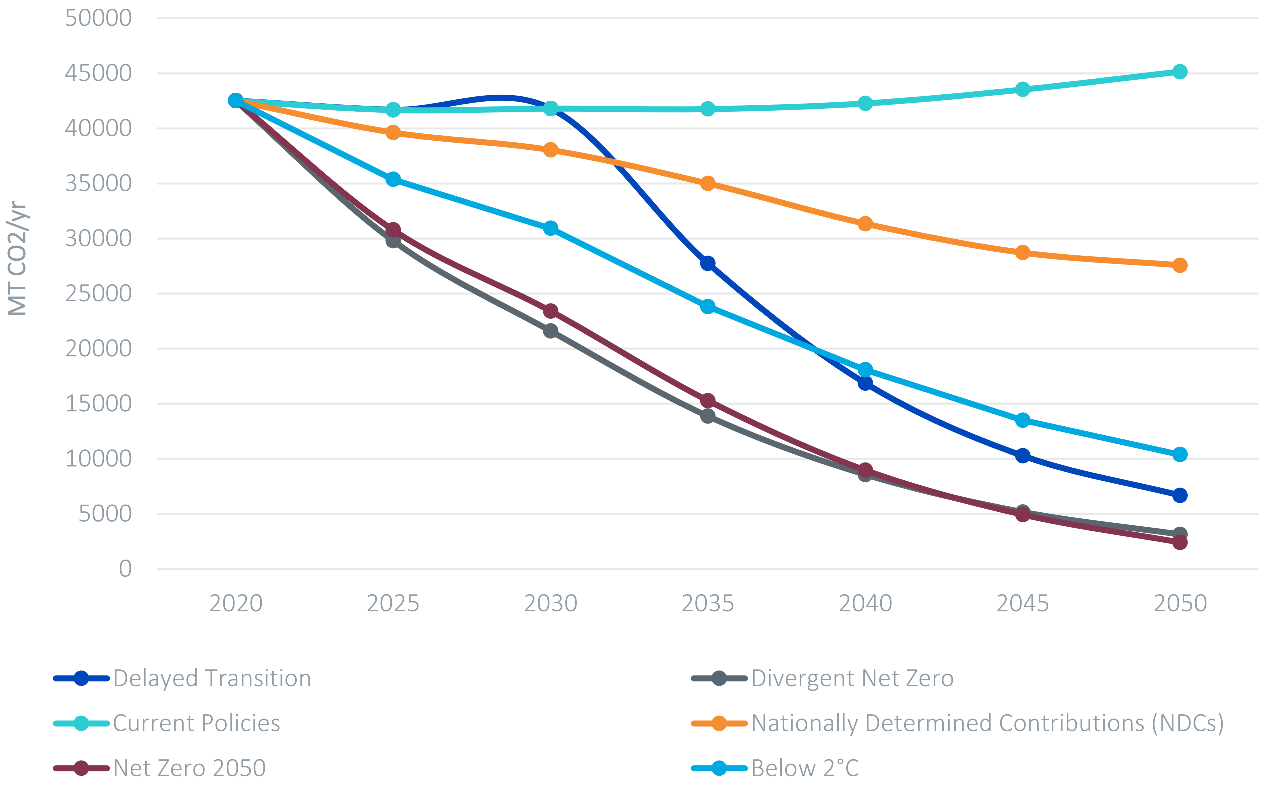
1. NDCs embody efforts by each country to reduce national emissions and adapt to the impacts of climate change. The Paris Agreement requests each country to outline and communicate their actions and update these every 5 years.
2. The Paris Agreement specifies 2°C as the upper limit of temperature change (relative to pre-industrialised levels) in the international legally binding treaty.
3. The ambition of the Paris Agreement is to limit temperature change to 1.5°C above pre-industrialised levels, but that is not legally binding.

Carbon emissions and carbon prices associated with different NGFS scenarios

Each of the NGFS scenarios entail vastly different carbon emission outcomes. At one extreme, **Current Policies** will see emissions continue to rise. At the other extreme, **Net Zero** (both orderly and disorderly) will likely pull emissions close to zero by 2050, but with significantly different transition risks (the 'disorderly net zero' will have the highest transition risks).

A **Delayed Transition** world will see emissions fall, but any real progress will only be made in over a decade. The **Below 2°C** scenario will see emissions fall in an orderly fashion and thus entail lower transition risks than the **Delayed Transition** scenario.

Figure 2: Carbon emission pathway scenarios



Source: NGFS Climate Scenarios Database, REMIND-MAgPIE model version 3.0-4.4. Data as of 2023. MT CO2/yr = Millions of tonnes of greenhouse gasses in carbon equivalent per year. **Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.**

For each of these scenarios the NGFS has estimated a carbon price path. These carbon prices are based on global-weighted averages (they aren't specific to the European, Californian, Chinese or UK systems, for example).

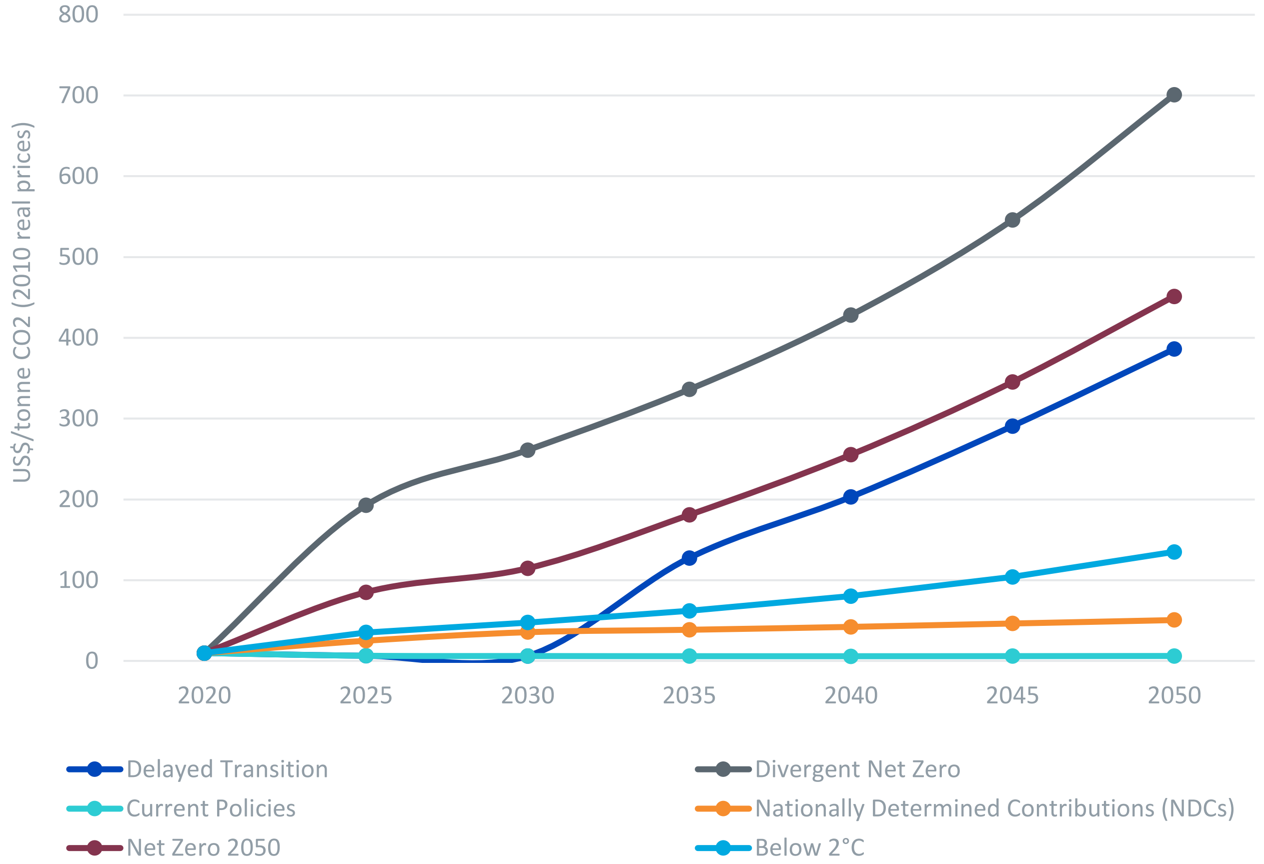
A key observation is that in all except the **Current Polices** scenario, carbon prices are likely to rise. Even in the **Below 2°C** scenario, we could see global carbon prices rise 14 times 2020 levels by 2050. In a **Delayed transition** scenario – where temperatures are only limited to the same level as the **Below 2°C** scenario – we could see prices rise 40 times 2020 levels by 2050. That is close to three times the **Below 2°C** scenario, illustrating the additional cost of delaying policy deployment.

More ambitious climate goals entail higher carbon prices, especially when uncoordinated **(Divergent Net Zero).**

In summary, the delays and lack of coordination represented by the disorderly scenarios are likely to drive higher carbon prices without a commensurate improvement in physical risk compared to their orderly counterparts.

Carbon markets offer a mechanism to hedge against the slow and uncoordinated policy action that largely describes the status quo of today.

Figure 3: Carbon prices scenarios



Source: NGFS Climate Scenarios Database, REMIND-MAgPIE model version 3.0-4.4. Data as of 2023. Global weighted average prices (not specific to a single Emission Trading System). **Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.**

Investable carbon markets

The two largest carbon markets in the world are the European Union Emissions Trading System (EU ETS) and the California Cap-and-Trade market. Together they account for over 90% of the value in global carbon markets in 2022[4].

Both carbon markets have highly liquid futures markets which provide investors access to their price developments and provide compliance entities (companies required by regulation to buy and surrender allowances to the government based on their emission activity) a tool to hedge against price movements.

Both European and Californian carbon futures have a very low correlation with traditional asset classes such as bonds, equities and commodities. Diversification is usually enhanced the lower the correlation between assets, hence carbon markets are very valuable for this purpose.

4. Source: Refinitiv Carbon Market Year in Review 2022, published February 2023.

What is bootstrapping? It is a Monte Carlo simulation approach that uses existing historical data instead of generating random data. It is a technique that uses random sampling from historical returns series with replacement. It is similar to a Monte Carlo simulation, but the main difference lies in how the different series of returns used in the calculations are generated: Monte Carlo generates random data series for a specific probability distribution given its generic moments (average returns, volatility…), while the bootstrap creates random data series by resampling with replacement from the historical series of returns. In other words, bootstrapping creates new series of returns by reordering existing historical series. This makes the bootstrap samples inherit the same distribution as the original data, allowing estimation of the sampling distribution of various statistics.

Figure 4: Asset performance correlation matrix

	US Equity	Global Equity	European Equity	Global HY	US Corporate	EU Corporate	EU Gov	US Gov	California Carbon	European Carbon	Broad Commodities	Gold
US Equity	1.00	0.97	0.82	0.69	0.33	0.37	0.03	-0.18	0.24	0.32	0.39	0.02
Global Equity	0.97	1.00	0.90	0.74	0.39	0.40	0.02	-0.17	0.23	0.36	0.47	0.09
European Equity	0.82	0.90	1.00	0.67	0.34	0.34	0.00	-0.14	0.17	0.39	0.42	0.08
Global HY	0.69	0.74	0.67	1.00	0.63	0.60	0.13	-0.03	0.26	0.28	0.44	0.19
US Corporate	0.33	0.39	0.34	0.63	1.00	0.80	0.60	0.64	0.19	0.18	0.21	0.30
EU Corporate	0.37	0.40	0.34	0.60	0.80	1.00	0.73	0.39	0.13	0.13	0.19	0.15
EU Gov	0.03	0.02	0.00	0.13	0.60	0.73	1.00	0.68	-0.07	-0.08	-0.12	0.13
US Gov	-0.18	-0.17	-0.14	-0.03	0.64	0.39	0.68	1.00	-0.09	-0.06	-0.12	0.28
California Carbon	0.24	0.23	0.17	0.26	0.19	0.13	-0.07	-0.09	1.00	0.14	0.15	-0.02
European Carbon	0.32	0.36	0.39	0.28	0.18	0.13	-0.08	-0.06	0.14	1.00	0.31	0.06
Broad Commodities	0.39	0.47	0.42	0.44	0.21	0.19	-0.12	-0.12	0.15	0.31	1.00	0.37
Gold	0.02	0.09	0.08	0.19	0.30	0.15	0.13	0.28	-0.02	0.06	0.37	1.00

Source: WisdomTree, Bloomberg. Dates: from January 1990 to June 2023. European equity and Global HY start from January 1999, EU Corporate and EU Gov start from June 1998, European Carbon starts from November 2007 and California Carbon starts from January 2015. **Historical performance is not an indication of future performance and any investments may go down in value.** US equity: S&P 500 Total Return Index; Global equity: MSCI World Net Total Return USD Index; European equity: EURO STOXX 50 Net Return EUR; Global HY: Bloomberg Global High Yield; US Corporate: Bloomberg U.S. Corporate Investment Grade; EU Corporate: Bloomberg Euro-Aggregate: Corporates; EU Gov: Bloomberg Euro Government; US Gov: Bloomberg US Government Bond; California Carbon: Solactive California Carbon Rolling Futures TR; European Carbon: Solactive Carbon Emission Allowances Rolling Futures TR; Broad Commodities: Bloomberg Commodity Total Return; Gold: LBMA Gold Price PM USD.

Somewhat surprisingly to some, the correlation between European and Californian carbon markets is extremely low at 0.14. That compares to a correlation of 0.82 between US and European equities. Such low correlations indicate that both carbon markets could be considered simultaneously as options to make a portfolio more efficient.

The price of each carbon market is driven by regional policies. When factoring in that there is very little international harmonisation of climate policies, and the role each policy tool plays in meeting climate goals can differ greatly by jurisdiction, it is less surprising that the correlation is this low.

Part 2: Identifying optimal carbon weights

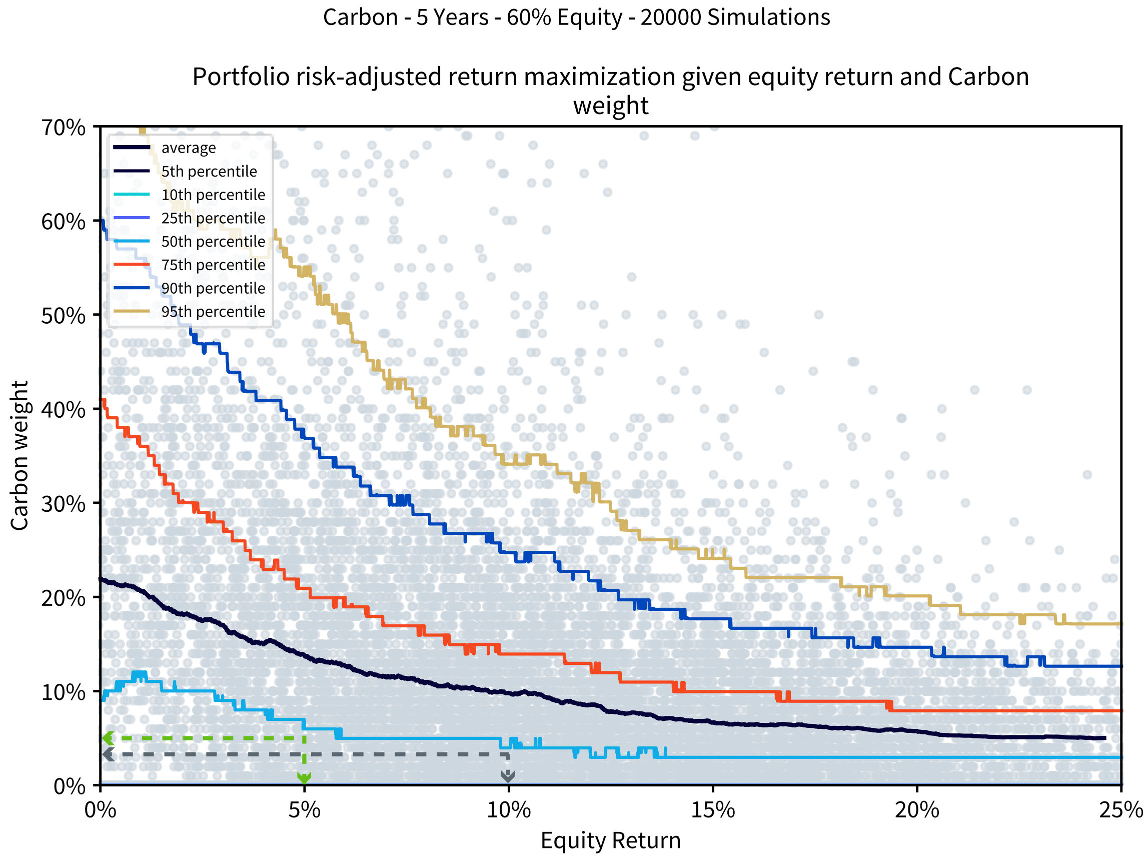
In this section, we present a framework to answer the same question: what is the optimal weight an investor should allocate to a carbon markets? For the purpose of this quantitative illustration, we use data from the European carbon market because it has a longer history and is more mature than other carbon markets across the world.

The procedure is as follows: we randomly select 60 months (equivalent to 5 years of data) with replacement from the monthly return time series for equity, bonds, and carbon[5]. This simulation represents an investor's hypothetical situation, considering 5 years of investment within the past 15 years. We repeat this process 20,000 times.

For each hypothetical realisation, we obtain three time series: one each for carbon, equity, and bonds. We maintain a fixed proportion between equity and bonds, following the well-known 60/40 split. Subsequently, we calculate the optimal weight an investor should assign to carbon to maximise the risk-adjusted return of their portfolio in that specific hypothetical investment. These optimal weightings are represented as grey dots in Figure 5. Each dot corresponds to a draw from our returns distribution, with the dots' y-axis representing the carbon weight that maximised the risk-adjusted return for that particular realisation, and the x-axis denoting the performance of the equities for that realisation, providing insight into the relative luck or unluckiness of selecting those 5 years from the available 15.

5. The bond time series is the Bloomberg US Treasury Total Return Index (LUATTRUU Index), the equity time series is the S&P 500 Total Return (SPX Index) and the carbon time series is the Solactive Carbon Emission Allowances Rolling Futures Total Return Index (SOLCARBT Index).

Figure 5: Risk-adjusted return maximisation with bootstrapping



Sources: WisdomTree, Bloomberg, S&P. From December 2007 to August 2023. Calculations are based on monthly returns in USD. Each grey point represents the equity return and the carbon allocation for which every realisation is maximised. The coloured lines represent various rolling percentiles, where the rolling window is made of 2000 simulations, that is, 10% of the total simulations. **Historical performance is not an indication of future performance and any investments may go down in value.**

The coloured lines on the graph represent percentiles. Let's focus on the light blue line, which represents the 50th percentile, (the median). For approximately a 5% equity return, or more precisely, for realisations with an annualised equity performance of around 5%, half the time an investor would have maximised their risk-adjusted return by allocating over 5% of their portfolio to carbon, while the other half of the time, they would have maximised it with a lower carbon weight (see the dashed green arrows).

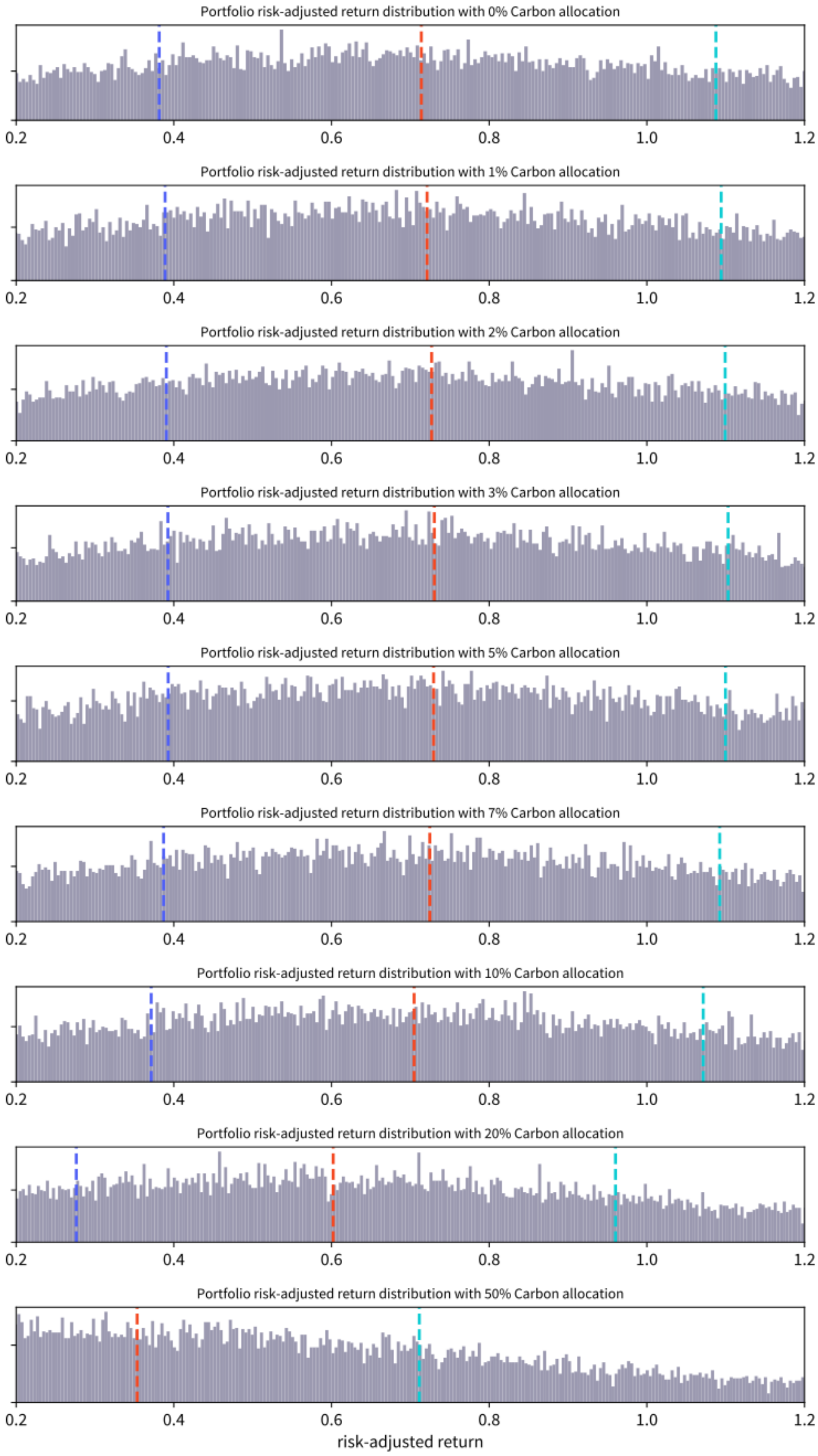
If the investor had been luckier and drawn a realisation corresponding to around 10% annualised equity performance, the median exposure needed to maximise the risk-adjusted return would have been lower, approximately 4% (see the dashed grey arrows).

In some instances though, investors can achieve the highest risk-adjusted returns without allocating to carbon. Specifically, when looking at the 25th, 10th, and 5th percentiles, we observe that these cases result in zero allocation to carbon (the three lines and the zero line are overlapping). In other words, approximately 25% of the time, investors can maximise their risk-adjusted returns without investing in carbon, regardless of the equity return.

In summary, the graph conveys the following message: as equity returns decrease, the likelihood that the portfolio with the best risk-adjusted return includes more carbon increases. For higher equity returns, the opposite holds true. Furthermore, given a certain equity return, the median case entails a small allocation to carbon to maximise the portfolio risk-adjusted return.

The challenge, of course, lies in the fact that investors typically have little insight into future equity returns over the next 5 years. As a result, it is often easier to approach the question from a slightly different perspective: given a certain allocation to carbon, how would my portfolio have performed? Figure 6 aims to address this question.

Figure 6: Risk-adjusted return distribution given carbon allocation



Sources: WisdomTree, Bloomberg, S&P. From December 2007 to August 2023. Calculations are based on monthly returns in USD. Each histogram represents the risk-adjusted return distribution for a given carbon allocation. The iris, orange and light blue lines represent the 25th, 50th (median) and 75th percentile respectively. **Historical performance is not an indication of future performance and any investments may go down in value.**

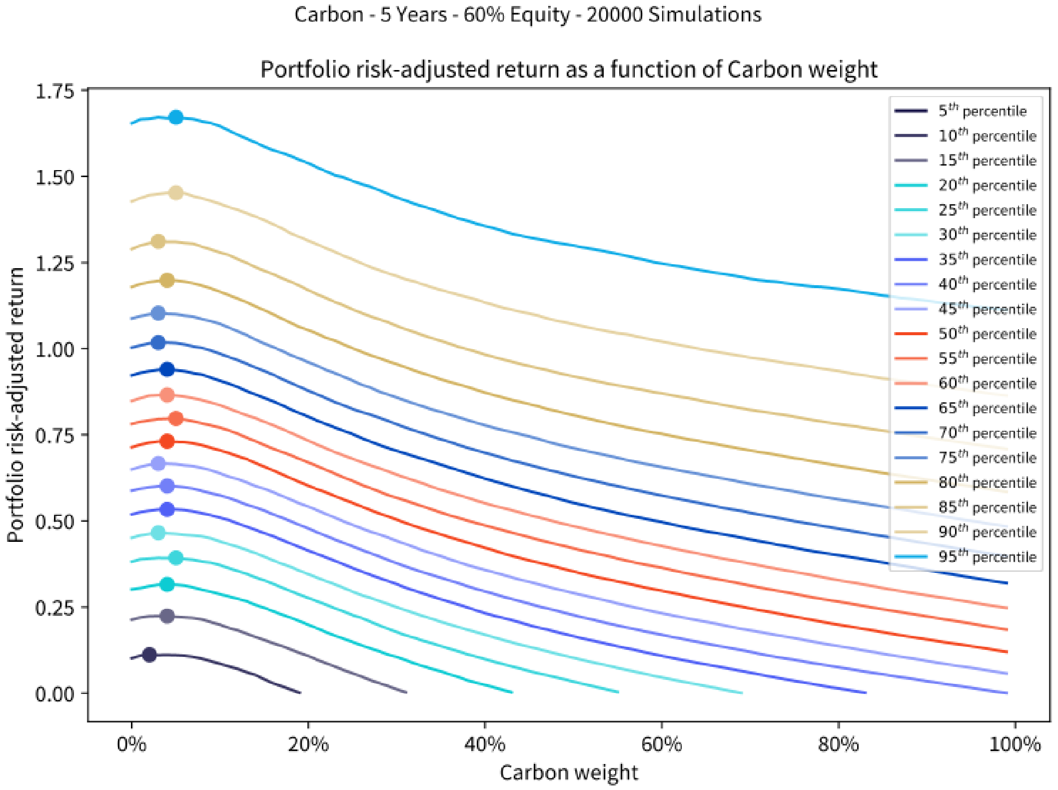
Starting from the top with a 0% carbon allocation, the 25th percentile would have yielded a risk-adjusted return of approximately 0.38 (indicated by the iris dashed line). To clarify, sorting all the 20,000 simulated risk-adjusted returns obtained when investing in a 60/40 portfolio (with no carbon) and selecting the 5000th worst (25% of 20,000) would result in a risk-adjusted return of 0.38.

Now, let's explore what happens when gradually increasing the allocation in carbon. The 5000th worst risk-adjusted return would improve gradually, reaching a peak at around a 4% carbon allocation. Beyond that point, the risk-adjusted return 25th percentile starts to diminish.

The previous example focused on the 5000th worst risk-adjusted return, but it's interesting to observe what happens when choosing different percentiles. For instance, considering the median (50th percentile, represented by the orange dashed line) or the 75th percentile (light blue dashed line) leads to similar behaviour as observed with the 25th percentile. Increasing the carbon allocation enhances the risk-adjusted return for the chosen percentile up to a certain point.

Summarising these findings in a single chart, we arrive at Figure 7, which illustrates how all these percentiles behave as we increase the allocation to carbon. Notably, for every percentile, the risk-adjusted return is maximised at approximately the same carbon allocation, which falls between 2% and 5%.

Figure 7: Risk-adjusted return maximisation with bootstrapping



Sources: WisdomTree, Bloomberg, S&P. From December 2007 to August 2023. Calculations are based on monthly returns in USD. Each line depicts the risk-adjusted return percentile as the carbon weight varies. The dots on each line represent its maximum. **Historical performance is not an indication of future performance and any investments may go down in value.**

Overall, through this bootstrapping analysis and using data for the last 15 years, we observe that for investment periods of 5 years, the optimal weight to allocate to carbon in order to maximise the risk-adjusted return would have been between 2 to 5%.

Part 3: Implementation solutions

WisdomTree has been a pioneer in developing tools for investors to access carbon markets. Our suite of exchange-traded commodities (ETCs) removes many of the barriers investors face when allocating to this asset class through a robust and time-tested ETC structure offering an opportunity to get exposure to the EU carbon allowances (EUA) and California Carbon Allowance (CCA) programs.

WisdomTree Carbon ETCs

The WisdomTree Carbon ETCs provide easy access to the prices of carbon allowances issued by the EUA and CCA programmes placing emphasis on liquidity and security, thus proving a fully collateralised exposure to December futures prices (where the greatest trading volumes lie).

WisdomTree Carbon

WisdomTree Carbon (JE00BP2PWW32) is a fully collateralised ETC providing exposure to the European Union carbon market. It is designed to reflect movement in the price of the ICE EUA (European Union Carbon Emission Allowances) front December futures contract (excluding fees).

WisdomTree California Carbon

WisdomTree California Carbon (JE00BNG8LN89) is a fully collateralised ETC providing exposure to the California carbon market. It is designed to reflect movement in the price of the ICE California Carbon Allowance Current Vintage front December futures contract (excluding fees).

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