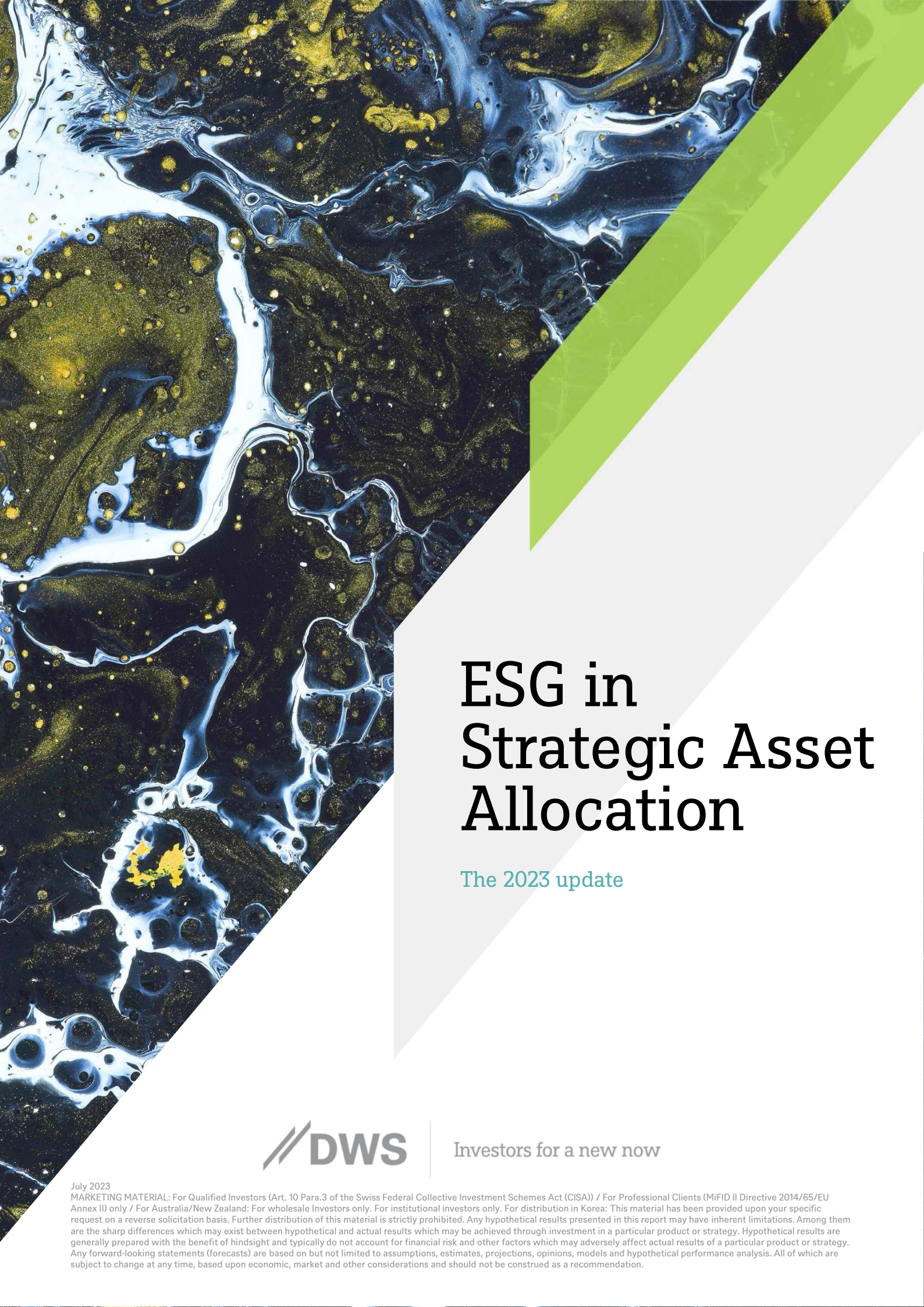

ESG in Strategic Asset Allocation

The 2023 update

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July 2023

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ESG in Strategic Asset Allocation (SAA): The 2023 update

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- Our 2023 update further enhances the ESG in Strategic Asset Allocation framework with a broader index set and seamless flexibility between indices. The greater flexibility and customisation enable investors to **harvest the full potential** of a SAA tilted to ESG at minimal Tracking Errors (TEs).
- This seamless optimisation across regions, sectors, ESG, and Paris Aligned (PAB) indices can **improve ESG outcomes at lower and higher tracking errors. We estimate an average ESG indicator performance improvement of 30% at 25bps** tracking error. This increases to 69% relative ESG indicator improvement on average for TEs as high as 200bps. This demonstrates that **our updated approach meaningfully improves ESG metrics at lower (25-75bps) and higher (150-250bps) tracking error thresholds.**
- The advantages of our ESG optimisation compared to a simple ESG or PAB index replacement strategy are considerable. Our ESG optimisation delivers roughly **1.5x the weighted ESG improvements of a simple ESG or PAB replacement** strategy at similar tracking error levels.
- Our case study demonstrates the **customisation options to achieve a specific investor's ESG and financial objectives.** The approach is able to deal with client specific (sub) asset class constraints, target volatilities, and customised ESG impact objectives.
- The new features increase the **usability in various different investor settings** ranging from model portfolios, customised SAAs for Institutional Investors to optimised Reference SAA's for ESG Mutual Funds.

Overview

In the EU and around the globe, tremendous efforts have been made in recent years to promote the transition to a more sustainable and climate-neutral economy. Sustainable Finance Agendas have helped to mainstream ESG considerations in the financial system. Although not free of critique, tremendous progress has been achieved through regulations and initiatives to support investors in integrating ESG considerations into their investment decision-making processes. However, when it comes to **addressing ESG challenges and combining ESG impact with individual institutional investors goals at the most comprehensive level** – the strategic asset allocation **(SAA) level** –these **regulatory initiatives only indirectly support these efforts.**

Thus, it is no wonder that simple SAA replacement strategies currently dominate solutions to solve these challenges. The replacement approach assumes that replacing the non-ESG index with the ESG/PAB/SDG-version generates the best achievable ESG outcome at a relatively low Tracking Error or whichever financial metric is determined. This replacement with ESG-indices is done at sub asset class level, constructing a final ESG replacement SAA.

This is where our approach differs. Our approach of ESG integration into SAA allows us to determine a combined ESG and financial optimum as a strategic reference incorporating fully flexible and customizable investor ESG and financial preferences. This means we can determine an ESG-tilted SAA with the highest weighted ESG improvement at the lowest

tracking error against an unconstrained, representative capital-weighted global universe. The TE at the SAA level is no longer a result of a simple replacement approach but is instead derived from a set of investor preferences that further optimises the allocation through an index portfolio. Different from optimisations on single security basis - that are hardly scalable - is our approach based on liquid, replicable indices to allow investability across ESG and non-ESG strategies.

Our approach continues to resonate with our clients and enjoys a high level of interest. Since 2020, we have been constantly improving our approach to integrate ESG at the Strategic Asset Allocation level. We are pleased to have achieved, with this third framework iteration, further milestones in 2023. It is hopefully useful to provide a strategic allocation guidance in this rapidly evolving ESG environment. It is probably still as true as it was three years ago: **Compared to its practical relevance, ESG integration in the SAA has room to evolve.**[1]

For this year we incorporate several enhancements that improve the usability of our approach including the enhanced index set which now includes Paris-Aligned indices and seamless flexibility between all indices (also the non-ESG indices provided that they have a sufficient ESG quality to warrant inclusion). The greater flexibility and customisation enable investors to harvest the full potential of transparent, investible indices at minimal Tracking Errors vs a traditional reference universe. This new feature increases the usability in various different investor settings ranging from customised SAAs for Institutional Investors to optimised Reference SAA's for ESG Mutual Funds.

Our study objectives remain unchanged. Our objective is to design and evaluate various approaches for enhancing the ESG metrics of a multi-asset portfolio while controlling the tracking error with respect to a traditional reference allocation.

Our ESG approach is a **mixed, multi-faceted approach** of not only **minimising typical exclusion criteria** (negative screening), but also in parallel **maximising ESG impacts** (positive screening). This is all performed on index level rather than on single security basis to allow for scalable implementation. We study the optimisation potential of using traditional indices, ESG/PAB replacements, and ESG/PAB optimisations.

Additionally, the most important new development is our (enhanced) combined optimisation approach. This approach uses regions, sectors, and ESG/PAB indices simultaneously to harvest the full potential of the investable universe. We also analyse if the **integration of Alternatives** is possible without diluting the ESG profile or risk-adjusted returns vs. traditional index SAAs and at low levels of tracking error.

A detailed summary of our 2023 analysis can be found at the end of the results section. The most important results can be summarised as follows:

- **Our new combined optimisation approach harvests the full ESG enhancement capabilities dominating our other optimisation methods.** This approach of allocating between all index types (standard regional, ESG, PAB, and sector) is particularly effective for low tracking error levels. The marginal benefit of increasing the tracking error by one unit is significantly larger for low tracking error levels. As little as 25bps of tracking error can be sufficient to improve ESG criteria on average by 30%.
- **Optimisation dominates replacement strategies by achieving roughly 1.5 times** the weighted improvements.
- We demonstrate that **Net Zero Pathway Aligned indices provide additional flexibility for the portfolio allocation.** These indices/ETFs can be used in tandem with standard ESG indices and can play an important role especially for the combined optimisation framework and carbon-focussed SAAs.
- **Our methodology can be easily adapted to pure fixed income or equity portfolios** accounting for slightly distinct effects on portfolio ESG metrics.

[1] See also e.g. Principles for Responsible Investment (September 2019). "Embedding ESG Issues into strategic asset allocation frameworks: Discussion paper." DWS participated in PRI working groups and shared results earlier on case studies like to model weights and tilts based on ESG indicators and climate resilience. We also like to add that DB Climate Change Advisors, a predecessor brand of the DWS Group, already published in 2010 about the integration of climate-related risks and opportunities into an SAA and presented how such an SAA can be normatively constructed (DBCCA: Investing in Climate Change 2010. A Strategic Asset Allocation Perspective).

Results

In the following section, we present the analysis of our 2023 outcomes, preceded by a concise recap of our methodology. As in the previous years we adhere to a balanced allocation of 50% equities (EQ) and 50% bonds (FI) in all our optimisations unless stated otherwise. Our conventional regional allocation is derived from the weights in the MSCI ACWI Index (EQ) and the Bloomberg Multiverse Index (FI).

We optimise the ESG benefit subject to a tracking error constraint for each of our pre-defined ESG scenarios numbered from 1 to 8 (see Figure 22). We introduce an additional SDG/Carbon focused scenario (Scenario 3b).

Unlike the last paper, we now use a unified tracking error calculation. We do not distinguish anymore between implementation and allocation tracking errors. Instead, we measure the tracking error of any portfolio against the traditional regional allocation. The tracking error is equal to the sum of the implementation and allocation tracking errors.

In addition to the traditional regional allocation, we also include the traditional sector allocation. The sector weights of the MSCI World are used to determine the weights for the sector replacement allocation. Theoretically, this sector replacement procedure should lead to a tracking error close to zero. However, we find a tracking error of around 50bps for the replacement strategy with sector indices. We identify three main sources of this discrepancy which we describe in more detail in the methodology section in the appendix. We presume that this implied "sector tracking error" will diminish with regular rebalancing in practical applications.

In the appendix we provide a comprehensive explanation of the premises and models that underpin our analysis.

1. Optimisation within the traditional asset allocation

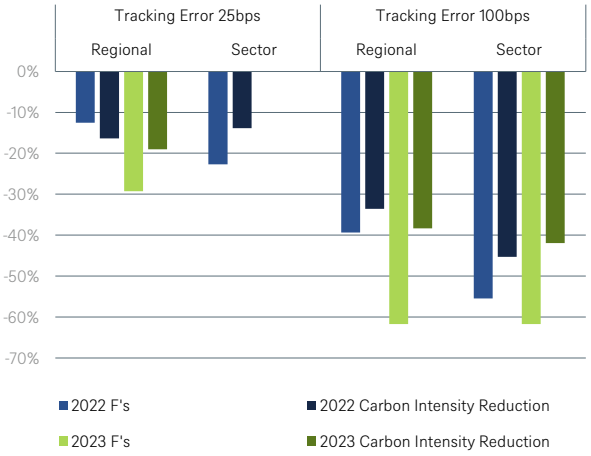
Our so called "traditional" allocation, which employs regional indices for the implementation of the equity allocation, is likely to be the most prevalent approach for constructing a standard multi-asset portfolio. Therefore, we will use this allocation as the baseline for our initial optimisations. As a first check, we compare the 2023 results with the 2022 results to illustrate data and methodological changes. *Figure 1* shows that this year's results are largely consistent with the previous ones but also reveal some novel insights. Some of these deviations are due to methodological changes, such as the unified tracking error calculation.

Starting to optimise within the set of traditional instruments, the previous findings have shown that small optimisations within traditional regional or traditional sectoral instruments are possible. With this year's update sector optimisations at less than 50 bps tracking error are not possible anymore due to the implied sector tracking error as explained before. We still optimise the ESG impact in each defined scenario depending on the respective tracking error restrictions. Within the regions the reduction of the share of the worst carbon and norm violators (Assessment F) can be as high as 29% compared to 12% previously (S1) at 25bps.

Last year's 16% carbon scope 1+2 intensity reduction increased to 19% in our 2023 update. For a higher tracking error of 100bps the carbon intensity reduction within traditional regions could be as high as 38% (34% previously) and for traditional sectors up to 42% (45%).

Especially for investors who are not willing to only use ESG/PAB indices optimising within sectors or regions could be a reasonable approach to improve the ESG profile of portfolios.

Figure 1. Relative ESG-improvements for regional and sector optimisation for tracking errors 0.25% and 1.00% scenario 1



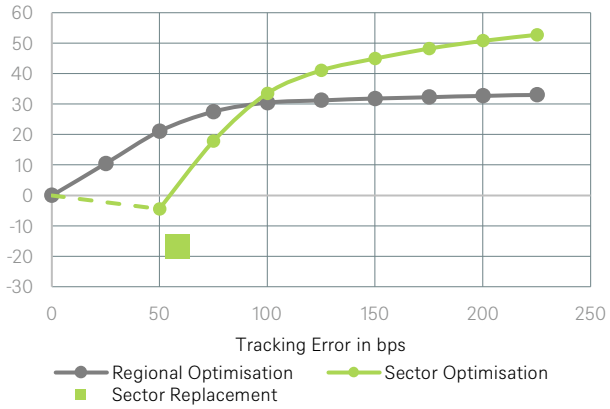
Source: DWS Investment GmbH. Data as of 30 December 2022

Figure 2 illustrates the difference between a regional and sectoral optimisation considering all ESG metrics in the weighted average improvements. The sector optimisation is superior to the regional optimisation for higher tracking errors. Certain sectors such as Health Care and Information Technology exhibit favourable ESG characteristics compared to traditional regional indices and are the main driver for the superior performance of the sector optimisation. The regional optimisation achieves a maximum improvement of around 33% whereas the sector optimisation reaches 53% for a TE of 225bps. The sector optimisation could be a more appropriate approach for investors who value ESG improvement over adherence to the traditional (regional) benchmark.

The presentation used in *Figure 2* serves us as a useful comparison tool when assessing trade-off between ESG

improvement and tracking error for different optimisation methods. Therefore, we will adopt this graphical representation consistently in this paper and incrementally introduce additional optimisations.

Figure 2. Weighted average relative ESG-improvements for regional and sector optimisation in scenario 8 (%)



Source: DWS Investment GmbH. Data as of 30 December 2022

2. Replacement of traditional indices with ESG and PAB

Building on our studies from previous years, we analyse in this section, the effect on ESG benefit and tracking error when the traditional regional allocation is completely replaced by ESG instruments while holding the weights constant. As a new feature in this year's update, we added four regional equity indices from the Solactive ISS ESG Net Zero Pathway index series. These indices comply with the EU Paris-Aligned benchmarks (PAB) criteria. Hence, we present a second implementation with PAB and ESG indices, where we replace equity indices with their corresponding regional PAB version. Fixed income (FI) indices are always substituted with their respective ESG version since no dedicated PAB indices are available on the FI side.

The standard ESG implementation comes with an average rolling 12m tracking error of 80bps from 30th April 2014 until 28th February 2023. The PAB/ESG has an average tracking error of 83bps during the same time period. The rolling 12m tracking error fluctuates between 40 and 140bps for both implementations (see *Figure 3*).

Figure 3. Rolling 12m tracking error of ESG implementation versus traditional asset allocation

Source: DWS Investment GmbH. Data from 30 April 2014 to 28 February 2023

In the course of 2021, we observed an elevated active portfolio risk driven by an increase of the TE of ESG equity indices. The PAB implementation also exhibits an increased tracking error in 2021 but the effect was less pronounced.

The ESG benefit of this approach is significant, and one could argue that it outweighs the additional tracking error incurred by the investor. The proportion of Assessment F-securities can be reduced by 84% (up from 78% in 2022) compared to the traditional SAA. The CO2 intensity is reduced by 25% (down from 55% in 2020). The carbon intensities of both the ESG and traditional implementation rose compared to previous levels. This phenomenon can be partly attributed to the high energy prices and the corresponding strong performance of energy companies.

On an adjusted basis carbon emissions decreased. This effect was especially strong for the carbon scope 1+2+3 intensity (adj.) being at 680 in 2022 compared to 960 in 2021 (in t/mln USD revenues) for the ESG implementation.

Figure 4 shows the share of solutions providers (SDG A and B-graded securities) improves by almost 25%. We observe comparable positive effects when switching to an ESG implementation for other KPIs like SBTi Share or carbon intensity.

Figure 4. Comparison of ESG data for ESG implementation and traditional asset allocation

Share	ESG	Traditional Regional
Controversial Sectors	0.5%	3.3%
F Assessments	2.1%	3.8%
E Assessments	11.1%	20.1%
SDG AB Assessments	38.7%	31.1%
SBTi Share	23.5%	19.2%
Carbon Scope 1+2 Intensity	183.8	246.4
Carbon Scope 1+2+3 Intensity (adj.)	678.7	920.9

Source: DWS Investment GmbH. Data as of 31 December 2022

The new implementation with PAB indices for equity and ESG indices for fixed income is similar to the ESG implementation.

Figure 5. Comparison of ESG data for ESG implementation and PAB implementation

Share	ESG	PAB/ESG
Carbon Scope 1+2 Intensity	183.8	179.6
Carbon Scope 1+2+3 Intensity (adj.)	678.7	640.9

Source: DWS Investment GmbH. Data as of 31 December 2022

However, we want to have a look at the carbon data for the two implementations. *Figure 5* illustrates that carbon intensity level improvement for the PAB/ESG version versus the standard ESG implementation is small (2% improvement). The adjusted carbon intensity however is decreased by almost 6% when comparing the PAB/ESG and the ESG implementation. Overall, we think Solactive PAB indices and MSCI ESG indices can be used interchangeably to improve the ESG metrics on the equity part of the portfolio.

As many investors are interested, at least in hindsight, how different strategic asset allocation implementations would have performed, we are adding a backtest analysis. We compare the traditional regional, ESG, and PAB/ESG implementations (see *Figure 6*). For the analysed time horizon, which was constrained by data availability, the empirical Sharpe Ratio of the ESG SAA was similar to the traditional SAA at 0.71 with the PAB/ESG strategy having a slightly higher Sharpe Ratio of 0.75. We want to note that the Solactive PAB indices are live since March 2022 but historical index values since 2014 are available. DWS, many other market participants and academia have researched extensively on the ESG–CFP (corporate financial performance) relation. The historical data suggests a small outperformance of the PAB/ESG implementation mainly resulting from the equity allocation which are implemented using the PAB index series. However, this effect should not be overstated given that the PAB indices have been live only since 2022 and any alpha before go-live has to be taken with a grain of salt.

The focus of this analysis is however not the alpha debate, but the optimisation of the combined ESG utility while controlling the TE. This ESG risk mitigation while contributing to overall societal goals at the potentially lowest deviation to traditional universe is at the heart of our combined optimisation.

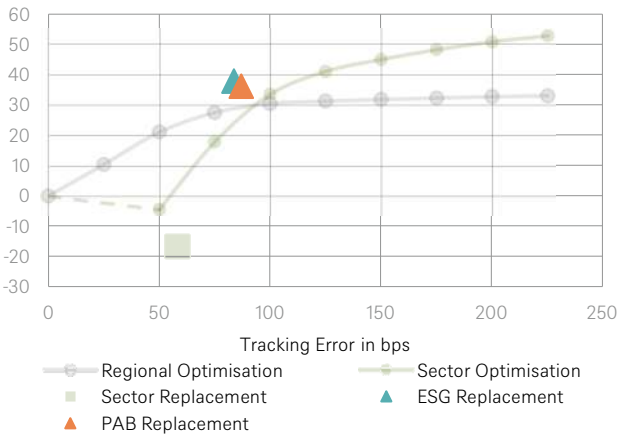
Figure 6. Empirical risk and return statistics for ESG implementation and traditional asset allocation

30 Apr. 2014 – 28 Feb. 2023	Traditional Regional	ESG	PAB/ESG
Compounded Annual Growth	5.9%	6.0%	6.4%
Annualised Monthly Volatility	8.3%	8.5%	8.6%
Sharpe Ratio	0.71	0.71	0.75
Worst drawdown	-20.0%	-20.1%	-19.7%
Median monthly return	0.8%	0.9%	0.9%
Best monthly return	6.5%	6.4%	6.7%
Worst monthly return	-8.4%	-8.0%	-7.9%
% of months with gains	66.0%	64.2%	65.1%
Correlation	1.00	1.00	0.99
Ann. Monthly Tracking Error		0.8%	0.9%
Information Ratio		0.10	0.59

Source: DWS Investment GmbH. Data from 30 April 2014 to 28 February 2023

We use the chart from the previous section to compare the replacement approaches with the regional and sectoral optimisation. The simple replacement strategy has a tracking error of roughly 80bps and achieves a weighted relative average improvement of 37% while the maximum improvement of the regional optimisation is 33% (see *Figure 7*). Hence, for a tracking error indifferent investor the ESG replacement is always superior compared to a regionally optimised implementation. But for higher tracking error levels, the sector optimisation is able to outperform the ESG replacement strategy.

Figure 7. Weighted average relative ESG-improvements for ESG-replacement in scenario 8 (%)



Source: DWS Investment GmbH. Data as of 30 December 2022

3. ESG and PAB/ESG Optimisations

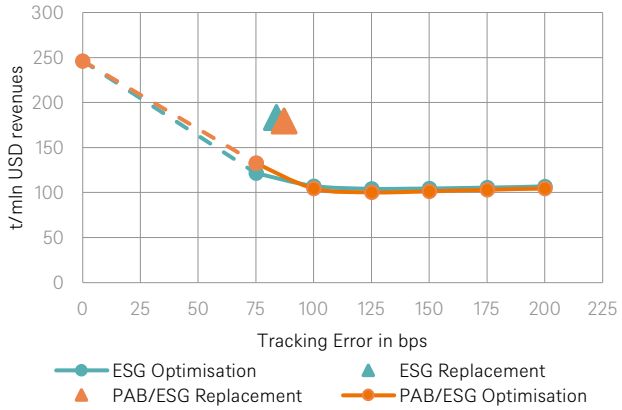
We have already covered our optimisation approach using traditional regions or sectors. Additionally, we have shown the beneficial impacts of an ESG or PAB/ESG replacement against a traditional reference portfolio. In the following, we introduce our optimisation approach based on ESG or PAB/ESG indices. This approach allows us to evaluate the trade-off between ESG improvements in an optimisation and the simplicity of substituting the traditional allocation with ESG indices without performing a full optimisation.

We adopt two distinct approaches. As a first approach we use an index set consisting of ESG indices as the basis for our ESG optimisation. This approach employs a set of ESG indices as the basis for our ESG optimisation, resulting in portfolios that consist solely of ESG indices. The second approach utilises both PAB and ESG indices, with regional PAB indices forming the equity allocation and standard ESG indices covering the fixed income side.

The following charts highlight that we are able to control the additional ESG facets in our Paris aligned scenario S5 (see *Figure 22*).

Figure 8 demonstrates the ability to optimise the CO2 intensity in scenario 5 and the additional value of an optimisation compared to a simple replacement. The advantage of the optimisation is apparent. At 75bps of tracking error Carbon Scope 1+2 Intensity emissions are reduced by 50%. The simple ESG replacement strategy achieves "only" a 25% reduction compared to the reference allocation at a TE of roughly 80bps. The optimisation achieves twice the improvement compared to the replacement. We can replicate this observation also in all other scenarios. Hence, we prefer optimising (if possible) instead of merely substituting the indices by their corresponding ESG or PAB/ESG versions.

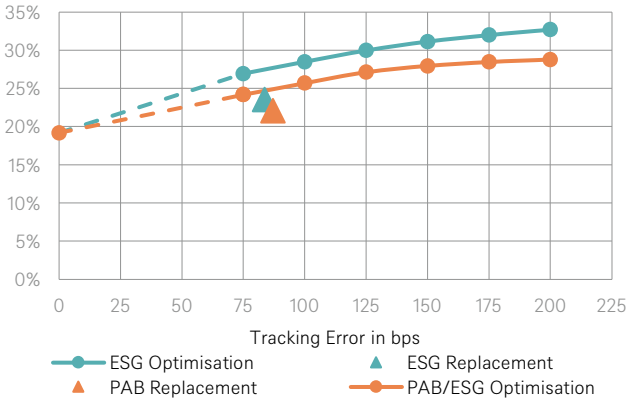
Figure 8. Carbon Scope 1+2 intensity scenario 5 – replacement and optimisation



Source: DWS Investment GmbH. Data as of 30 December 2022

The SBTi share of the portfolio increases from 19% to 27% (42% relative increase) for the optimised portfolio at 75bps (see *Figure 9*). The replacement strategy improves the SBTi share to 24% only (26% relative improvement). The difference between optimisation and replacement is significant and strengthens our preference for optimisation compared to replacement. From a top-down perspective, NZAM (Net Zero Asset Managers Initiative) path modelling, including various additional ESG facets, appears therefore plausible to us. This should be ideally accompanied by an effective bottom-up engagement strategy with firms, sovereigns, or project owners to really reduce real world carbon emissions for the investments. Blind faith in the sole effect of capital allocation can be short-sighted.

Figure 9. SBTI share scenario 5 – replacement and optimisation

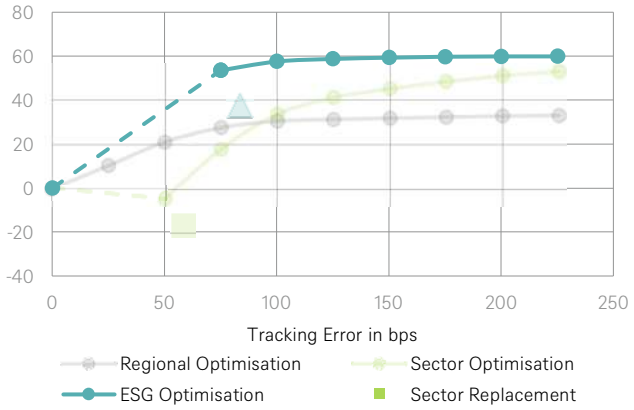


Source: DWS Investment GmbH. Data as of 30 December 2022

Again, we find the PAB replacement strategy to be roughly equivalent with the ESG replacement strategy.

We complete our ESG optimisation analysis by incorporating the weighted average ESG improvements for the optimisation approach in *Figure 10*. Compared to the replacement strategy, sector optimisation, and regional optimisation the ESG optimisation is superior and provides significant ESG improvements. At 100bps tracking error the weighted average improvement obtained from ESG optimisation is at around 60% compared to 34% (sector optimisation), 30% (regional optimisation), and 38% (ESG replacement).

Figure 10. Weighted average relative ESG-improvement for ESG-replacement in scenario 8 including ESG-optimisation (%)



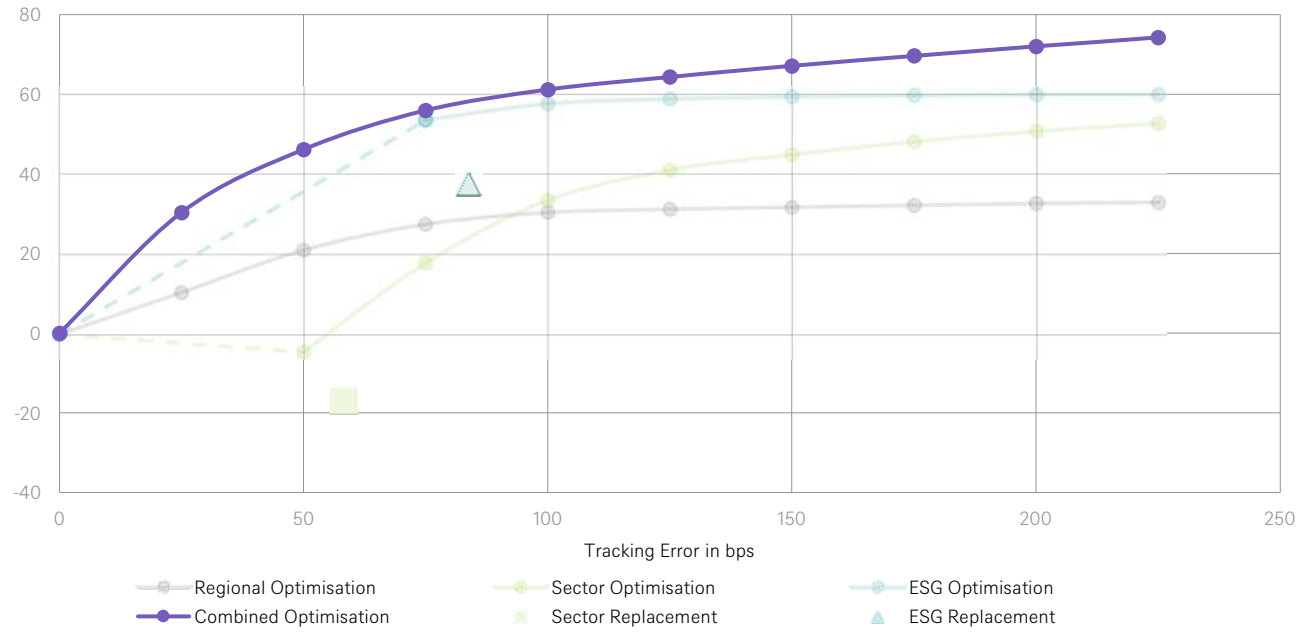
Source: DWS Investment GmbH. Data as of 30 December 2022

For tracking errors above 50bps we prefer an optimisation on ESG or PAB/ESG indices over the other methods. *Figure 10* illustrates the need for an optimisation framework which performs better for low tracking errors. Hence, we decided to run our optimisations using standard regional, sectoral, ESG and PAB indices all at the same time. By construction, we will find admissible solutions for any tracking error level since the reference allocation is a subset of the opportunity set. We present our findings in the next section.

4. Combined Optimisations

We introduced our combined optimisation approach earlier and briefly summarised the benefits for portfolio construction. In this section, we will delve deeper into this optimisation approach. We broaden the opportunity set by using any index in our optimisation universe (regions, sectors, ESG, and PAB) at the same time. To make our analysis more comprehensive, we add our combined optimisation method to the mix we have previously introduced. *Figure 11* displays the weighted relative ESG improvements for all four approaches, including the ESG optimisation and the combined optimisation approach. The results are evident: optimising outperforms replacing with ESG/PAB/Sector indices in all scenarios and methods. Furthermore, the combined optimisation method emerges as the best performer in every situation.

Figure 11. Change of the weighted relative ESG-improvement in dependency of tracking error in scenario 8 (%)

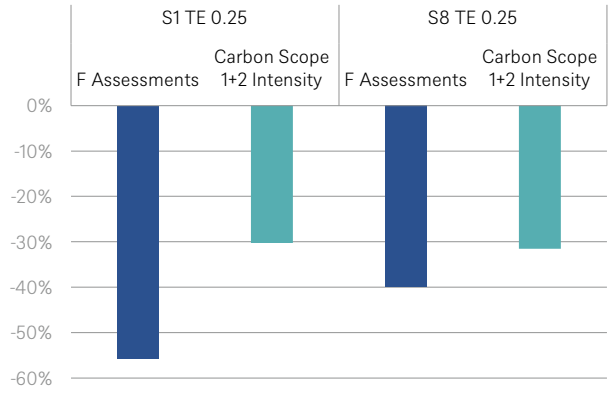


Source: DWS Investment GmbH. Data as of 30 December 2022

From a mathematical point of view this behaviour is as expected since the opportunity set is the largest. Additionally, we were able to demonstrate that the advantage of the combined approach is relatively large. The benefit of one additional unit of tracking error is significantly larger in the 0-50bps TE range than for higher tracking error budgets. On the other hand, the combined approach allows for more ESG improvements at the higher tracking error budgets since it allows for significant sector allocations.

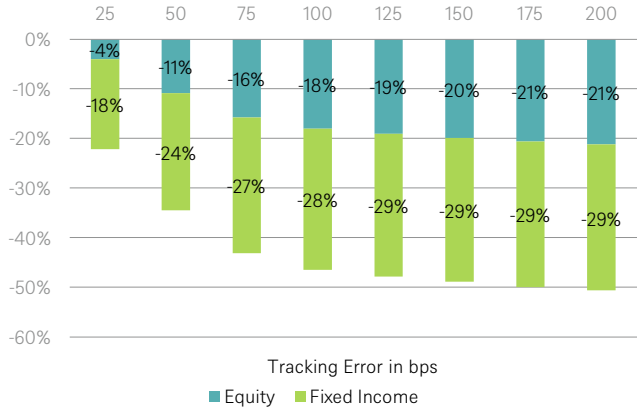
At 25bps tracking error we achieve a carbon intensity reduction of up to 30% and 55% less F-Assessment securities for scenario S1 (see *Figure 12*). We find comparable results for scenario S8.

Figure 12. Assessment F and carbon intensity reduction in S1 and S8 for combined approval



Source: DWS Investment GmbH. Data as of 30 December 2022

Figure 13. Carbon Scope 1+2+3 intensity (ADJ) reduction by asset type (S8)



Source: DWS Investment GmbH. Data as of 30 December 2022

We believe the combined approach is particularly suitable for investors who want to stay as close as possible to their conventional reference allocation. With as little as 25bps tracking error budget the ESG improvements are substantial while keeping the deviation from the benchmark minimal. For almost all ESG metrics the combined approach improves the KPI more than twice as much as the traditional regional optimisation does. At 25bps tracking error the traditional approach reduces carbon intensity by 13% while the combined approach achieves a more than 30% reduction (Scenario 8). We do not find a single ESG metric for which the combined optimisation approach produces inferior results compared to the traditional approach.

In order to assess the relative contribution of each asset class we split improvements by asset class. *Figure 13* shows that the FI component dominates the carbon intensity reduction for low tracking error portfolios, while the EQ and FI components have similar contributions for high tracking error portfolios. This is consistent with the fact that the FI component has a higher absolute carbon intensity than the EQ component in the reference portfolio (58% vs 42%).

Consequently, the majority of the emission reduction can be attributed to the FI part of the portfolio. The average weighted relative enhancements from the equity and fixed income components exhibit comparable magnitudes for elevated tracking errors. Conversely, the fixed income component yields more pronounced relative enhancements for lower tracking error budgets (see *Figure 13* and *Figure 14*).

Figure 14. Weighted relative improvements contribution scenario 8

Source: DWS Investment GmbH. Data as of 30 December 2022

FI and EQ asset classes contribute to ESG improvement in similar but slightly different ways. However, we see the opportunity to apply our methodology also to pure EQ or FI portfolios. We construct two novel portfolio strategies accordingly. The first strategy is an exclusive equity implementation derived from the MSCI ACWI weights and the second strategy is an exclusive fixed income implementation derived from the weights of the Bloomberg Multiverse Index. These exclusive EQ/FI allocations also function as the reference allocation for TE computation in the respective scenario.

The fixed income portfolio exhibits rapid enhancements in the overall weighted relative improvements at low tracking error levels, but with constrained potential for enhancements at high tracking error levels. At tracking error levels of 250bps or more we find the improvements on the equity portfolio to be equal or larger than on the fixed income portfolio (see *Figure 15*).

The portfolio composition results in a markedly elevated Carbon Scope 1+2 Intensity for the fixed income portfolio relative to the equity portfolio (330 vs 163 t/mln USD revenues). The fixed income portfolio exhibits a more rapid carbon intensity reduction due to its nearly twofold higher carbon intensity than the equity portfolio. This is further facilitated by relatively lower tracking errors for the ESG indices versus a conventional index on the FI side. At 50bps of tracking error, the carbon intensity reduction for the fixed income portfolio is approximately 44%, while the equity portfolio achieves a 22% reduction. At 100 bps of tracking error, both portfolios converge in terms of relative carbon intensity reduction and attain a roughly 58% reduction for both portfolios.

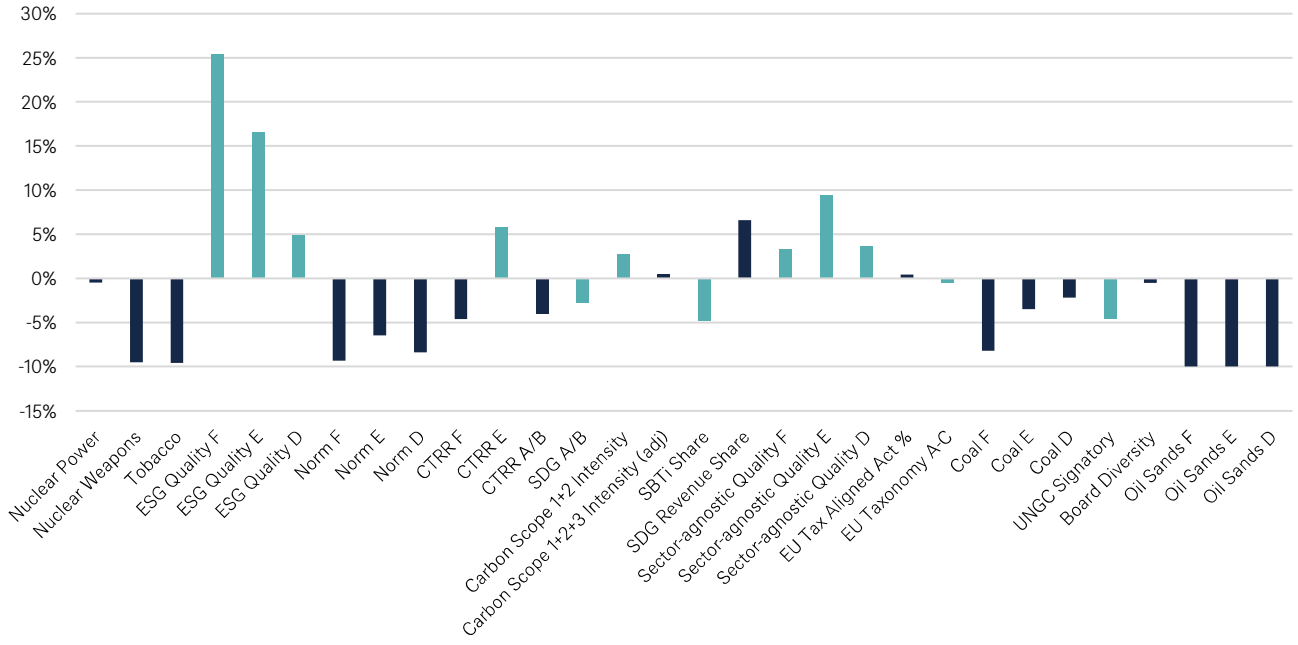
All of the analyses in the paper have thus far employed a 50/50 EQ/FI allocation. However, we stress that all of our findings are also valid in an allocation incorporating alternatives. We apply a 45/45/10 EQ/FI/Alt split for our analyses including alternatives. Within the Alternatives bucket the four indices are market capitalisation weighted. The Alts bucket comprises REITs, Infrastructure Equity, Private Debt, and Infrastructure Debt. Notably, the proportion of green bonds in the Infrastructure Debt index has increased substantially compared to the previous year.

Figure 15. Weighted average relative improvements scenario 8 (%)

Source: DWS Investment GmbH. Data as of 30 December 2022

Figure 16 shows the changes of the traditional SAA if we blend in a 10% weight in alternatives. The blue (petrol) indicators highlight where alternatives are context specific proportionally better (weaker) against the excluding alternatives universe. The overall picture is in line with last year's result except for the increase in ESG Quality Assessments F, E, and Ds. To be more conservative in our index level KPIs, we exclude companies without ratings when aggregating ESG Quality Assessments at the index level. Previously, these companies were included.

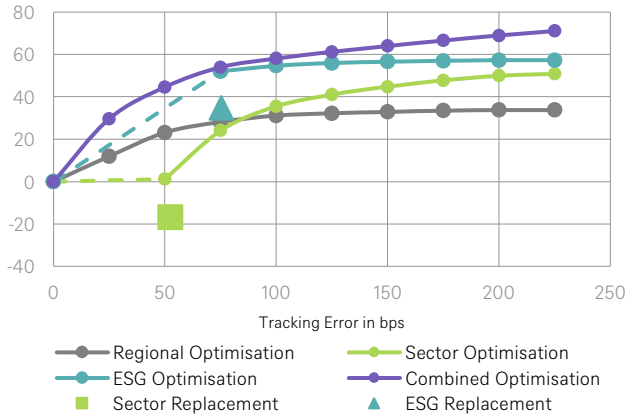
Figure 16. Relative changes of traditional SAA if blending in a 10% weight in alternatives (%)



Source: DWS Investment GmbH. Data as of 30 December 2022

Figure 17 is an extension of our plots on weighted relative ESG improvements in previous sections and is now based on an optimisation including Alternatives. Most importantly, we do not see any significant changes against our version excluding alternatives. This demonstrates that all of our approaches are working well in both contexts, with and without alternatives. Again, the performance of the combined optimisation method is superior compared to all other methods and – for low TE budgets – the only valid option for optimising ESG metrics besides optimising on the existing traditional regional allocation with rather limited ESG improvement potential.

Figure 17. Change of the weighted relative ESG-improvements in dependency of tracking error in scenario 8 (%) – including alternatives



Source: DWS Investment GmbH. Data as of 30 December 2022

ESG customisation – Case Study

The previously outlined results are based on our standard scenarios and utility functions. The following case study shall demonstrate how fully flexible our approach is to be adjusted to achieve a specific investor's ESG and financial objectives.

Our ESG portfolio construction methodology allows for customisation across all optimisation parameters to solve for the optimal ESG improvement for an investor's ESG utility function at a given relative risk budget. ESG utility customisation allows for prioritisation and weighing of the ESG improvement measures shown in *Figure 17* at proportions consistent with an investor's ESG objectives, whether narrow or broad. Furthermore, asset class constraints can be introduced to display any sort of regional or sectoral bias as intended by the client. For example, sector allocations could be controlled to stay within upper/lower bounds absolute or relative to the benchmark.

This optimisation can also be adjusted to different starting strategic asset allocation mixes at the asset class, sub-asset class or geographical level. DWS's ESG optimisation methodology outputs a granular, transparent ESG asset allocation at given tracking error targets that can be customised across asset allocation parameters and customisable ESG impact objectives.

In this case study, we define the following parameters and objectives:

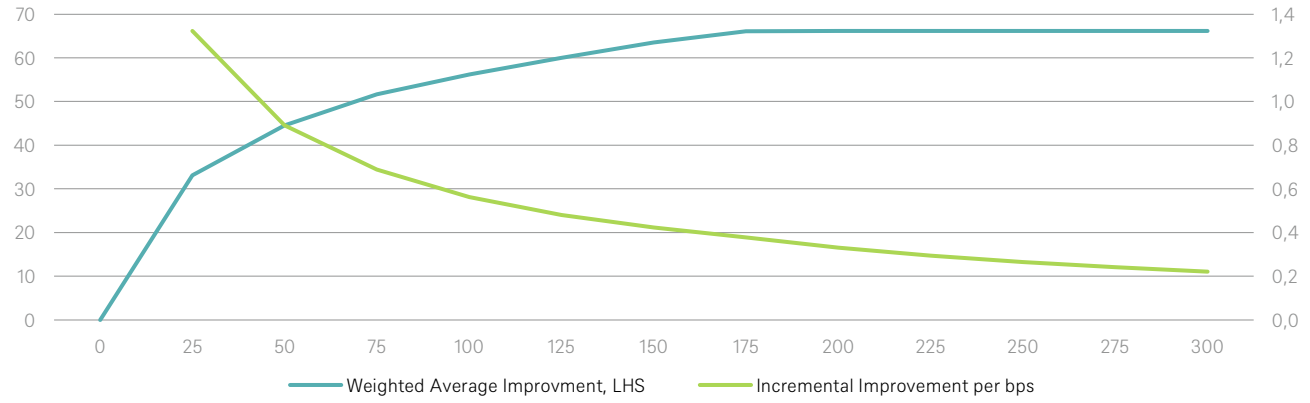
1. Global multi-asset allocation with constraints reflecting the European bias of the client
2. Set maximum levels for Equity (25%) Fixed Income (75%) Alternatives (15%)
3. Target a portfolio volatility of 7%
4. Ensure adherence to client specific constraints, e.g., upper/lower bound for High Yield exposure,
5. Set the TE limit of 150bps vs traditionally optimised SAA
6. Define the ESG objectives of the client: Increase SDG revenue exposure and reduce carbon intensity

To translate these parameters into a recommended SAA, we engage in the following steps:

1. Combine DWS Long View 10-year risk and return forecasts to create an optimised strategic asset allocation of traditional indices using DWS's GRIP portfolio construction framework[2].
2. Construct a customised scaling vector to reflect client's preferences regarding SDG revenue and carbon intensity.
3. Use combined optimisation approach to obtain ESG SAA with highest ESG improvement as defined by scaling vector at the different tracking error levels.
4. Analyse results and put particular focus on ESG improvement vs tracking error to select the appropriate portfolio for the client.

As previously mentioned, we find the highest incremental ESG improvement per bps of tracking error for low tracking error levels (25-75bps) as shown in *Figure 18*. Without any other constraints or preferences, the 25bps TE portfolio seems like a reasonable choice. However, it is worthwhile to examine the KPIs in more detail. While the 25bps TE portfolio has SDG revenues increased by 85% compared to the traditional SAA, the 50bps portfolio achieves an improvement of 141%. For carbon intensity the reductions are at -33% for the 25bps and -40% for the 50bps variant. Given the improvement in the client's two key ESG objectives at a relative risk threshold well within the 150bps defined TE limit, we would recommend the 50bps portfolio.

Figure 18: Weighted relative ESG-improvements (in %) in dependency of tracking error



Source: DWS Investments GmbH. Data as of 30 December 2022

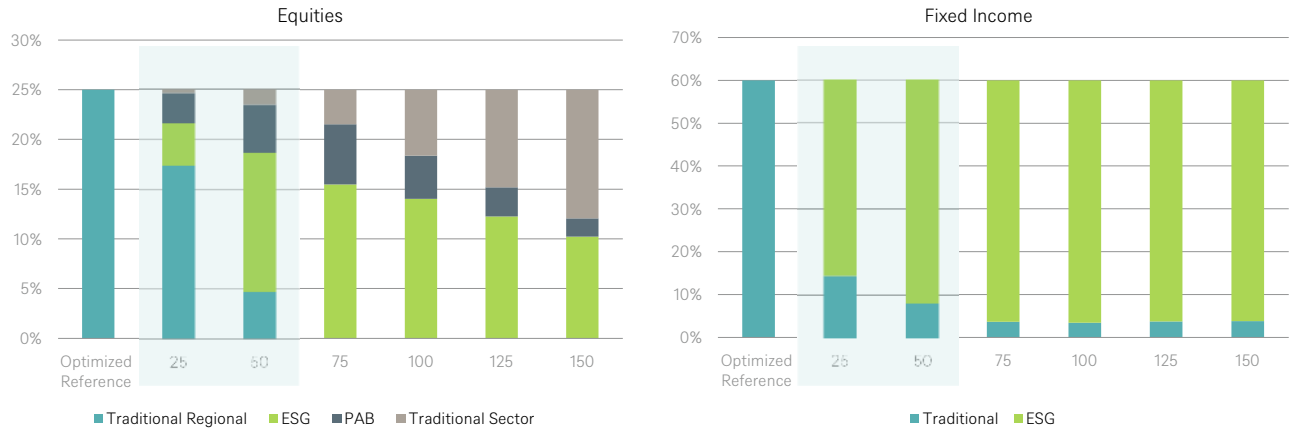
[2] https://www.dws.com/en-gb/insights/global-research-institute/time-to-get-a-grip2/

ESG customisation – Case Study (continued)

The combined optimisation for our customised parameters utilises a blend of ESG/PAB index replacement as well as sector tilts to achieve the optimal SDG/carbon improvement at the defined risk level or limit. *Figure 19* illustrates the allocations to ESG/PAB and sector indices across equities and fixed income for the customised ESG SAA. We highlight a few noteworthy characteristics of the combined optimisation:

— A sizeable portion of European equities is shifted from MSCI Europe to MSCI Europe ESG when increasing the tracking error target from 25 to 50bps
— ESG and Paris-aligned benchmark impact is not uniform across regions. For European equities, ESG is preferred over PAB for SDG/carbon measures whereas Japan and EM, PAB is preferred.
— EUR ESG corporates replace non-ESG corporates at the lowest tracking error targets, consistent with observations from *Figure 17* that show significant carbon intensity reduction in fixed income even at low tracking error levels
— At increasing levels of tracking error allowance, sector allocations are increasingly meaningful, with increasing weighting toward global health care particularly at 75bps and higher.

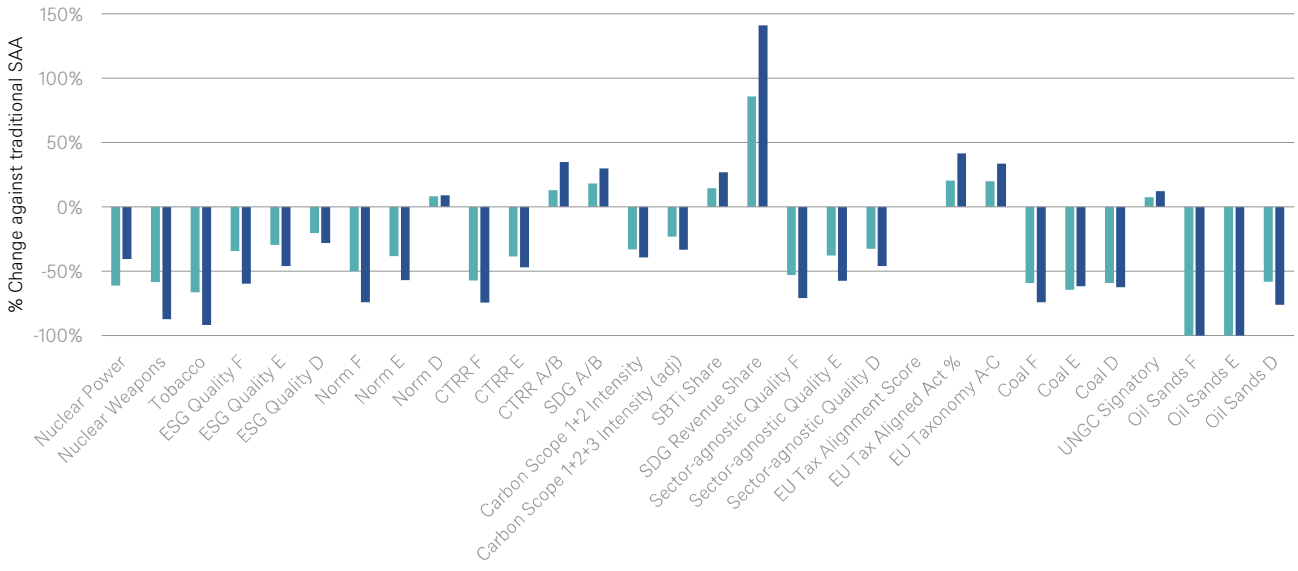
Figure 19. Change in allocation by category versus standard optimisation



Source: DWS Investments GmbH. Data as of 30 December 2022

Figure 20 shows the relative change across all ESG measures for two optimised ESG portfolios at 25bps and 50bps tracking error level vs the traditional SAA.

Figure 20. Relative change in targeted ESG measures versus traditional SAA at 25bps and 50bps TE levels



Source: DWS Investments GmbH. Data as of 30 December 2022

Conclusion

The incorporation of environmental, social and governance (ESG) factors into portfolio management is a topic of ongoing debate and research in the asset management industry. The regulatory framework and the investor demand for ESG are evolving. We present some **methodological enhancements that increase the flexibility and customisation of ESG integration** in a multi-asset context, although our methodology can also be applied to single-asset classes such as fixed income or equity. **We propose a new optimisation technique that improves the trade-off between ESG performance and risk-return objectives, and we refine our tracking error estimation method**. Furthermore, we include Paris Aligned Equity Indices as an alternative benchmark for ESG-oriented investors. It is important to emphasize that real-world ESG impact by such an optimized portfolio is mostly indirect. In order to increase impact beyond the selected ESG KPI's, it is important to supplement this SAA approach with a Stewardship Strategy and a Selection strategy to allocate e.g. Green Bonds and other investments with a direct, primary financing link. There is however broadening scholarly evidence that impact via capital allocation and (reciprocally) divestments, as well as other channels like signalling present important impact channels (Wilkens et al. 2023, Caldecott et al. 2022)[3]. We summarise our main results as follows:

- Our **enhanced combined optimisation** approach harvests the **full ESG enhancement capabilities** of the entire index set. The enhanced optimisation method outperforms other optimisation methods in terms of ESG enhancement for any given level of tracking error. This optimisation approach is particularly valuable at low tracking error budgets. The marginal benefit of increasing the tracking error by one unit is significantly larger in the 0-50bps TE range than for higher tracking error budgets. With this new method, a tracking error of only 25bps can be sufficient to achieve substantial ESG improvements. **At 25bps the combined approach could improve all ESG criteria on average by 30%** which increases to 69% relative improvement on average for TEs as high as 200bps. We want to point out that the combined optimisation approach will produce admissible solutions also for arbitrarily small tracking error levels. Small allocations in traditional (but ESG-tilted) sector indices are important to achieve the full ESG tilt in an optimised portfolio based on ESG and PAB indices.
- We demonstrate that an **optimisation approach is always preferable to an unsophisticated replacement strategy** with ESG/PAB/Sector indices across all scenarios and optimisation methods. The **optimisation approach achieves 1.5 times the weighted improvements** of a replacement strategy at comparable tracking errors. Moreover, we observe that an ESG/PAB replacement strategy inherently entails a tracking error which is around 75bps in our model. Our framework allows to construct portfolios that has lower than 75bps TE, with slightly higher ESG credentials.
- The inclusion of **Net Zero Pathway Aligned indices/ETFs** gives room to steer a portfolio in the desired direction. We have demonstrated that theses ETFs achieve a similar tracking error and lower carbon emissions than standard ESG indices. **Hence, we consider the Net Zero indices as a viable alternative to standard ESG index series**.
- Additionally, our tracking error calculation methodology update makes results more comparable. This is especially helpful when assessing the effects of a replacement strategy or and optimisation on ESG/PAB/sector indices. Assuming the average reader/investor thinks of his reference allocation in regional terms (similar to our reference allocation) this change in TE calculation makes our results more tangible.
- Fixed Income assets and equities have similar but slightly different impacts on the portfolio ESG metrics and their enhancement. FI assets tend to have worse KPIs but higher relative improvements due to the low tracking error of the standard FI indices and their ESG counterparts. For higher TE levels the difference between FI and EQ becomes almost negligible. Our equity allocation has slightly better KPIs compared to the FI allocation within our chosen reference allocation.
- **The methodology** is intended and designed for multi-asset portfolios primarily but **can be also applied to pure fixed income or equity portfolios**.
- Within our **case study** we presented a simplified **client interaction advisory scenario**. It illustrates the steps from the initial client request to the final portfolio allocations obtained by applying either a standard mean-variance or GRIP optimisation method, followed by an ESG optimisation method using our enhanced combined framework. The ESG implementation incorporates distinct types of equity indices, such as conventional regional, ESG, PAB and sector indices. **This showcases ideally the comprehensive applications and flexibility of the DWS ESG SAA approach**.

[3] Wilkens et al. (2023): The Impact of Sustainable Investment Funds – Impact Channels, Status Quo of Literature, and Practical Applications Caldecott et al. (2022): Sustainable Finance and Transmission Mechanisms to the Real Economy

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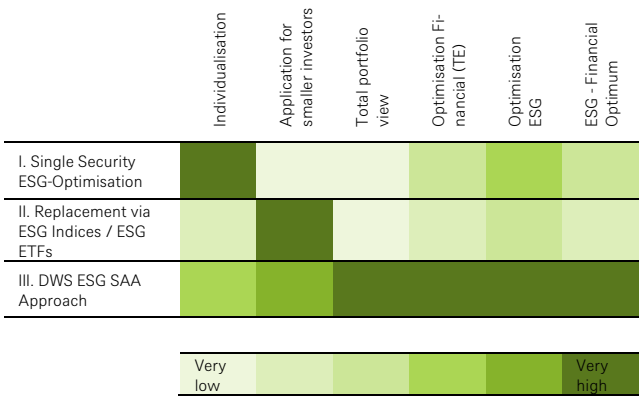
Appendix

DWS Approach to ESG in SAA

If investors want to assess the ESG implications on a strategic asset allocation level, they have to overcome several restrictions. Therefore, a holistic view of portfolio ESG impact is essential for a comprehensive portfolio construction of ESG portfolios. It needs to be highlighted, that its useful to not solely optimise on ex-post basis, but also incorporate where possible, ex-ante estimates. This is additionally provided by our proven long-term return forecasting model - the DWS Long View framework.

To date, we observe two main approaches for the integration of ESG aspects in the market. It is either the integration of a single security focused ESG-Optimisation for portfolios or a general replacement to ESG Indices or ESG ETFs. Both approaches have their strength and weaknesses.

Figure 21. DWS approach to ESG in SAA approach in comparison



DWS Investments GmbH. As of 30 December 2022.

The first approach is very individual, allowing investor-specific consideration of ESG criteria. Unfortunately, this is typical only possible for larger investors. It allows as well only a partial portfolio view as the optimisation is only applied for a sub-asset class. The portfolio tracking error is typically an outcome of the ESG restrictions. Therefore, it remains for such optimisations approaches unclear if a combined ESG and financial optimum was reached.

The other option is switching to ESG indices / ETFs for integration in the SAA – the replacement approach. This cannot consider any individual ESG restrictions of investors as the approach is very much determined by existing indices / ETFs / funds, but this approach is easy implementable for different investor groups. Still, it presents a partial portfolio view with the tracking error defined by the ESG approach or the index construction. Whether a combined ESG / financial optimum is achieved remains, however, unclear.

The DWS ESG SAA approach allows an optimisation based on readily available instruments (ETFs that mirror ESG indices) making it applicable in a wide set of solutions. One of the advantages of our approach is that various individual SAA specifications can be taken into account, while at the same time an implementation is possible for different investor groups. Our model always takes a total portfolio view as all asset classes in a multi asset portfolio are considered in an integrated way. Based on a defined set of parameters, the determination of a combined ESG and financial optimum (based on defined ESG indicator weights and the ex-ante allocation TE) is possible. Our approach therefore can demonstrate how positive and negative ESG factors, like various exclusions, CO2 intensity, SDG factors, EU Principles Adverse Impacts or EU Taxonomy considerations can be implemented with the lowest possible active risk in the SAA compared to a SAA based on traditional indices.

The achieved impact varies depending on the recalibration approach, the selected indices/universe, data availability, degrees of freedom, the ESG restrictions and different ESG target functions, the traditional risk/return restrictions, and the potential trade-offs between ESG and financial metrics. As such, exploring this trade-off across simulated approaches allows investors to determine the appropriate ESG SAA construction methodology by comparing the empirical output of both financial and ESG metrics for a variety of possible steps of ESG optimisation.

As a caveat of the many necessary: all our analyses are based on the belief in the underlying data and models. Often, a pinch of salt is however necessary for deriving the right implications considering the fuzziness of ESG data and imperfections of risk / return estimates. However, we consider this large, representative investment set sufficient to draw solid conclusions as we not only select liquid, representative indices with sufficient ESG data coverage and base our modelling on tested engines.

Methodology

Based on many discussions and iterations, we think the evolved methodology in this year's paper increases comparability between the different optimisation methods and introduces a new way of optimisation approach. In particular, we amended the tracking error calculation, included additional PAB indices, and introduced an optimisation harvesting the full ESG potential of our index set. The following steps describe our ESG SAA construction approach. Notable changes in methodology will be highlighted.

1. **Define the subset of appropriate asset classes and ESG indices on which to construct ESG SAAs.** ESG implementation can take on a variety of different characteristics.

Therefore, for the purposes of transparency, investability, and liquidity of our ESG SAAs, we chose the list of indices highlighted in the following section on which to run our analysis. We added four new regional PAB regional equity indices based on the Solactive ISS ESG Net Zero Pathway Index Series in our 2023 update.

2. **Define and quantify ESG metrics.** In order to properly account for various ESG metrics, we utilise a step-by-step optimisation of which each step incorporates an additional ESG metric on which to optimise our SAAs. In addition, we illustrate how investors can increase the impact across ESG metrics if they have increased flexibility in their mandates in terms of tracking error.
3. **Establish risk parameters** for initial optimisations. Maximum deviations of regions/sectors/sub-asset classes of maximum 4x weight/minimum 1/4 weight of the traditional SAA. Absolute portfolio risk (i.e. portfolio volatility) is controlled to match the volatility of the reference allocation of 50/50 Equity/Fixed Income or 45/45/10 Equity/Fixed Income/Alternatives.
4. **Define our target scenarios** based on ESG metrics and risk parameters (see *Figure 22*).
5. **Run the optimisations** for every scenario S1 to S8 for traditional indices, sector indices, and PAB/ESG indices for tracking errors ranging from 25bps to 300bps in 25bps increments. In each of the scenarios, we maximise the ESG composite score[4] subject to the risk constraints.

For our methodology, we ran each of the four following iterations to compare results across different initial approaches (see *Figure 23*):

1. Optimisation within traditional regions/sectors/asset classes.
2. Replacement strategies, i.e. traditional regions/asset classes are substituted by their corresponding ESG/PAB version (PAB only available for EQ).
3. Optimisation with ESG (or PAB/ESG) asset classes
4. Combined optimisation using regions, sectors, and ESG/PAB indices simultaneously to harvest full potential of index set.

Figure 22. Definition of target scenarios based on ESG metrics and risk parameters

Target Scenarios

S1: Minimise Climate Transition Risks ("CTR") and UN Global Compact ("UNGC") risks via excluding F-graded securities in the respective categories

S2: (additionally) Minimise DWS ESG Quality Assessment F-graded securities (S1+S2)

S3a: (additionally) Minimise CO2 intensity, maximise Solutions Provider (A and B-graded securities for SDG-Assessments and CTR-Assessments (S1+S2+S3a)

S3b: Minimise CO2 intensity, maximise SDG Revenue Share (S1+S2+S3b)

S4: (additionally) Minimise controversial sectors + minimise DWS ESG Quality Assessment share for E-graded securities (S1+S2+S3a+S4)

S5: Paris aligned: minimise CO2 intensity, maximise SBTi share, minimise coal, and oil sands share

S6: Principle Adverse Impact focus: additionally minimise waste and water intensity, maximise UNGC signatory, maximise board diversity (S5+ S6)

S7: EU Taxonomy focus: additionally maximise EU Taxonomy alignment score and aligned revenues (S5 + S6 + S7)

S8: Multi Facet Extended: scenarios S4 + S7 combined

Source: DWS Investments GmbH. Data as of 30 December 2022

[4] For the indices of the asset class universe the quantified ESG scores (step 2) are joined in an ESG raw data matrix. By using the median[4] score of each metric and by using the weights of a reference allocation (benchmark), the raw data is normalised to ensure comparability. A scenario-specific scaling vector (step 4) is then applied to the normalised ESG score matrix in order to assign the relative importance to each metric in the corresponding scenario. Finally, the *ESG Composite Score* is defined as weighted average of this normalised and scaled ESG score matrix and a portfolio allocation.
By comparing the ESG Composite Score of two different allocations, a higher ESG Composite Score indicates a better ESG profile in the specific scenario (and vice versa). The optimisation process aims to find the allocation that yields the maximum ESG Composite Score, i.e., the best ESG profile in the corresponding scenario.

Figure 23. Overview of set of indices used

Asset Class	Sub-Asset Class	Traditional Regional Optimisation	Traditional Sector Optimisation	ESG Optimisation	PAB/ESG Optimisation	Combined Optimisation
Equity Regional	MSCI USA	X				X
	MSCI USA ESG			X		X
	Solactive USA Paris Aligned				X	X
	MSCI Europe	X				X
	MSCI Europe ESG			X		X
	Solactive Europe Paris Aligned				X	X
	MSCI Japan	X				X
	MSCI Japan ESG			X		X
	Solactive Japan Paris Aligned				X	X
	MSCI EM	X				X
	MSCI EM ESG			X		X
	Solactive EM Paris Aligned				X	X
Equity Sector	MSCI World Communication Services		X			X
	MSCI World Consumer Discretionary		X			X
	MSCI World Consumer Staples		X			X
	MSCI World Energy		X			X
	MSCI World Financials		X			X
	MSCI World Health Care		X			X
	MSCI World Industrials		X			X
	MSCI World Information Technology		X			X
	MSCI World Materials		X			X
	MSCI World Utility		X			X
Fixed Income	EUR Govt	X	X			X
	EUR Govt ESG			X	X	X
	US Treasury	X	X			X
	US Treasury ESG			X	X	X
	EUR Corporates	X	X			X
	EUR Corporates ESG			X	X	X
	US Corporates	X	X			X
	US Corporates ESG			X	X	X
	EUR HY	X	X			X
	EUR HY ESG			X	X	X
	US HY	X	X			X
	US HY ESG			X	X	X
	EM Sovereign	X	X			X
	EM Sovereign ESG			X	X	X
Alterna-tives	Private EUR Infrastructure IG	X	X	X	X	X
	REITS	X	X	X	X	X
	Equity Infrastructure	X	X	X	X	X
	Private Direct Lending EUR	X	X	X	X	X

Source: DWS Investments GmbH. Data as of 30 December 2022

Defining the index universe

ESG investing can take many forms, through either active or index-based investing, through liquid public markets or through illiquid private investments, through exclusion criteria or via impact scores. For this analysis which details DWS' approach to creating liquid global strategic asset allocations, our empirical studies leverage a set of ESG market indices that are: investible, liquid, and transparent. The PAB indices which are included in the 2023 update also satisfy these three requirements.

The reference universes for the analysis are the MSCI AC World for equities and the Bloomberg Multiverse for bonds. The default allocation is determined by the current weights of regions, sectors, or sub-asset classes in these indices. Especially on the FI side, we filter the index and scale the weights accordingly, e.g. securitised assets are not considered. The equity/bond allocation is set at a static 50/50 ratio. We have also calculated all scenarios with a dynamic equity/bond weighting. However, since the ESG effect is, in this case, potentially distorted by allocation shifts, we apply a static asset class weighting. The ESG optimisation is performed separately within the equity and fixed income components. In the new analysis, we also include alternative indices from S&P for leveraged loans and REITs as well as Dow Jones and Markit iBoxx for infrastructure. In this case, the allocation of equities/fixed income/alternatives is set to a ratio of 45/45/10. No ESG version is applied for alternative indices.

On the equity side, the MSCI ESG Leaders indexes were identified as ensuring good ESG characteristics while at the same time keeping the tracking error to the original/non-ESG indexes within a reasonable range. Furthermore, when looking at the exclusions and UN norms alignment embedded into these indexes, we found a good degree of homogeneity with the DWS ESG assessments. For this year's update, we added four regional equity indices from the Solactive ISS ESG Net Zero Pathway Index series to illustrate different implementation options. These indices comply with the EU Paris-Aligned Benchmarks criteria and have GHG emissions that are consistent with the Paris Climate Agreement's long-term global warming goal. Furthermore, these indices have a comparable tracking error as the MSCI ESG indices relative to the conventional index, while outperforming the MSCI ESG indices in terms of carbon emission metrics.

On the FI corporate (European IG) side, we chose the Bloomberg Barclays MSCI Euro Sustainable and SRI TR, and the Bloomberg Barclays MSCI US Liquid Corp Sustainable Index for the US IG Corporates asset class. In conjunction with these indices, DWS offers a broad set of best-in-class passive ESG solutions that can be used to practically construct these SAAs with relative ease. The PAB indices can be also easily implemented using DWS' passive solutions.

Defining and quantifying ESG metrics

For our analysis, we find that the above subset of ESG indices can be used to establish a meaningful approach that is consistent with many ESG investors objectives on climate change and various ESG topics including the UN Sustainable Development Goals (SDGs). In total, as shown in *Figure 16* we select a set of typical ESG indicators which are reasonably controllable on index level. Many of these ESG exclusions are also enforced across these indices by the index provider indirectly and, by consequence, our ESG SAAs (e.g., controversial weapons exclusion "CCW").

We recognise that our findings are based on parameters we have established as meaningful but not absolute levels of ESG compliance; therefore, investors can toggle the ESG goals we are using as they deem fit.

Establishing risk parameters

As with ESG metrics, we recognise that investors can toggle their relative and absolute risk criteria based on desired outcomes. In combination with ESG metrics, utilizing our optimisation framework, one should be able to establish the trade-off between risk and ESG efficacy.

For the purposes of our analysis, we establish a set of relative risk parameters. First, we limit the maximum deviations of the regions, sectors, and asset classes at a maximum of 4 times and minimum of ¼ times the weight of the traditional reference SAA. Absolute portfolio risk is made equivalent to the reference allocation of a static 50/50 traditional equity/fixed income or 45/45/10 traditional equity/fixed income/alternatives allocation. We control the relative portfolio risk - the expected tracking error of the optimised vs. reference allocation - to not exceed the defined TE limits.

In any of the optimisations we measure the tracking error of the optimised allocation against the traditional regional reference allocation. With this approach we enhance comparability between the different methods and can also more easily quantify the tracking error which is introduced by an ESG replacement or ESG optimisation. In addition to the traditional regional allocation, we also include the traditional sector allocation. The sector weights of the MSCI World are used to determine the weights for the sector replacement allocation. Theoretically, this sector replacement procedure should lead to a tracking error close to 0. However, we find a tracking error of around 50bps for the replacement strategy with sector indices. There are three main reasons for this discrepancy:

1. We use a historical covariance matrix to calculate the tracking error estimate analytically. However, the historical covariance matrix may not match the current sector weights exactly because the sector allocations change over time.

2. We do not include the Real Estate sector in our sectoral allocation, which causes some extra tracking error (Real Estate weight was about 3% on Dec 22).
3. The mapping of the MSCI ACWI onto only 4 regions (USA, Europe, Japan, and EM) is reasonable but slightly inaccurate, and adds to the tracking error.

For practical applications, we expect this "sector tracking error" to largely disappear given regular rebalancing.

Defining the target scenarios based on ESG metrics and risk parameters

Once we have established the appropriate index universe, the ESG metrics, and clear parameters around relative SAA risk, we define our target scenarios around those definitions as shown in *Figure 22*.

We concentrate in the presentation of the results section on scenario 8. Scenario 8, as the most comprehensive ESG optimisation, includes minimising the carbon footprint, controversial activities, and further weak ESG-graded securities and also optimises positive criteria such as the share of solution providers. Furthermore, a few exhibits are based on Scenario 5 reflecting a Paris Alignment scenario.

Our case study is based on a customized scenario defined by our hypothetical client. This scenario is not part of *Figure 22*.

For the calculation of the ESG utility in the various scenarios we normalise the respective ESG values. For the presentation of the partial ESG utility (e.g., the share in Quality Assessment F, CO2 intensity) and the total ESG utility (improvements across different ESG criteria) we show the weighted overall improvements in percentages.

This analysis is three-fold. First, assessing the ESG quality of the unconstrained asset allocation along standard ESG parameters, the level of carbon risks and compliance with the UN Global Compact norms. This analysis is conducted on a look-through basis across the incorporated index holdings.
As a second step, we perform a trim-and-fill analysis where we underweight asset classes or regions with insufficient ESG performance. We fill the allocation gaps pro rata with the remaining assets classes/regions. We also assess relative over- and underweights against the traditional 50/50 and the new 45/45/10 allocation based on various constraints.

Third, we remodel our standard asset allocation based on ESG-index solutions, while considering implementation requirements such as sufficient liquidity. The overall goal is to design an ESG-aware asset allocation, which represents a relative optimum of tracking error (compared to the default SAA) while at the same time maximizing the ESG quality. We outline different scenarios and trade-offs.

The first scenario/optimisation framework taken into consideration targets the minimisation of exposures to controversial sectors and F-graded Climate Transition Risks and UN Global Compact companies (according to the DWS ESG Engine methodology). In the second scenario, the minimisation of F-graded companies based on the DWS ESG Quality Assessment is additionally sought. Iterations 3a and 3b consists of also minimising the carbon intensity of the resulting portfolio and seeking max SDGs and climate solutions (positive) impact. The fourth framework additionally includes constraints around minimising E-graded companies and controversial sectors across the board. The set of further scenarios includes optimisation with respect to Paris alignment metrics or at optimising a selection of EU Principle Adverse Impact related indicators. In line with the previous focus, a scenario targeting the EU Taxonomy is implemented. The last scenario is a combination of minimising E-graded companies and controversial sectors while maximizing contributors to the EU Taxonomy. The latter is because of current data gaps however experimental.

Running the optimisations

The central optimisation parameter is the maximisation of the combined ESG Composite Score in the respective scenario, subject to the tracking error restriction. We finally run the optimisations for every scenario S1 to S8, using five different asset universes:

1. Traditional allocation (i.e. regional indices for EQ and standard FI indices)
2. Sector allocation (i.e. sector indices for EQ and standard FI indices)
3. ESG allocation (i.e. ESG regional indices for EQ and ESG FI indices)
4. PAB/ESG allocation (i.e. PAB regional indices for EQ and ESG FI indices)
5. Combined (i.e. all indices in one optimisation)

We then maximise the aforementioned "ESG Composite Score" on tracking error allowances ranging from 25bps to 300bps, run in 25bps increments (i.e., 25bps, 50bps, 75bps, etc...).

Our analysis is based on various utility functions[5] of the composite ESG score and the TE. Especially for a pure ESG implementation an investor would need to accept a tracking error of roughly 75bps vs the traditional regional allocation. The ESG improvement per increment of tracking error is higher for low tracking error budgets compared to high tracking error budgets. Our combined optimisation approaches demonstrate the attractiveness of low tracking error budgets. Historical back testing supports that at these levels, the Information Ratio and Sharpe Ratio are relatively comparable to the unconstrained SAA. Tracking error allowances beyond 250bps could not only produce large risk/return deviations but may even reduce the relative ESG impact.

Forecasts are based on assumptions, estimates, views, and hypothetical models or analyses, which might prove inaccurate or incorrect.

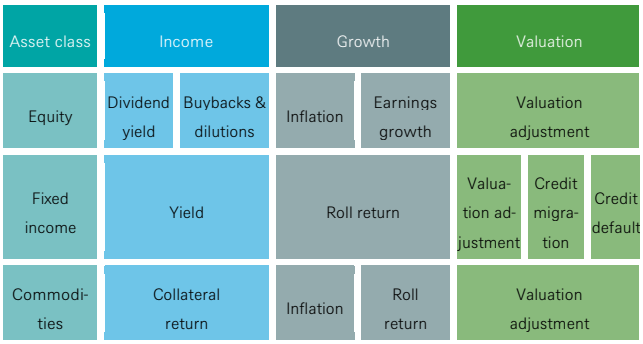
[5] **Combined Utility Function:** In the optimisation process the ESG Composite Score is maximised for various tracking error budgets. The result of the optimisation is the allocation that yields the best possible ESG profile for the given tracking error limit. If an investor faces the choice between two allocations with the same tracking error, it is assumed that the allocation with the higher ESG Composite Score is preferred. At the same time, we assume that an investor is averse to taking active portfolio risk: ceteris paribus, a higher tracking error will decrease the investor's utility. This preference structure is described by a combined utility function that uses the two parameters ESG Composite Score and tracking error. Both preferences are linked by an individual active risk aversion coefficient. It thereby describes the trade-off an active-risk averse investor faces upon deviating from a reference allocation in order to improve the ESG profile.

The Long View: ESG Forecasts

The financial metrics previously illustrated are empirical calculations of our ESG-optimised scenarios. As with all financial analysis, empirical data is only helpful as far as baseline expectations can be anchored in historical observation. As the landscape for both traditional and ESG investing continues to shift dramatically, forward looking expectations of risk and return that properly account for the financial impact of ESG are tantamount to optimal portfolio construction. Look-through ESG metrics are more likely to be stable, although investors should consider the ESG impact of potential broad shifts in capital allocation behaviours.

To construct strategic asset allocations, DWS relies on the DWS Long View, our firm-wide methodology for forecasting strategic, 10-year returns, correlations, and volatilities across a breadth of public and private investment universes. The DWS Long View leverages a consistent and transparent building block approach that aggregates fundamental return drivers across three pillars: income, growth, and valuation. *Figure 24* illustrates our building blocks across traditional asset classes.

Figure 24. Pillar decomposition for traditional asset classes in DWS long view



Source: DWS Investments UK Limited.

The 2021 annual publication ***DWS Long View: the green decade***[6] introduced our initial set of 10-year forecasts for a subset of traditional ESG asset classes. These forecasts utilise the same three -pillar approach we use for traditional asset classes. The persistence of ESG as a risk or return factor is not considered for these forecasts, although the 2022 annual publication ***DWS Long View: the return implications of climate risk***[7] explores the potential risks of adverse climate scenarios on capital markets returns. These 10-year return forecasts for ESG and traditional indices are shown in *Figure 25*.

Figure 25. 10y return forecasts p.a. in local currency

	PAB	ESG	Traditional
Equity			
ACWI Equities		6.6%	6.8%
World Equities	7.6%	6.6%	6.7%
EM Equities	8.0%	6.7%	7.5%
US Equities	7.6%	7.2%	6.8%
Europe Equities	7.8%	7.0%	6.7%
Japan Equities	4.6%	4.3%	4.7%
Fixed Income			
EUR Treasury		2.7%	2.7%
EUR Corporate		3.9%	4.0%
EUR High Yield		5.9%	6.2%
US Treasury		4.1%	4.1%
US Corporate		4.8%	5.0%
US High Yield		6.8%	6.8%
EM USD Sovereign		5.8%	7.6%
EM USD Corporate		5.6%	7.1%

Source: DWS Investments GmbH. Data as of 30 December 2022

The expected returns of traditional, ESG, and PAB indices are similar, as we anticipated. However, some differences do exist. For instance, the EM PAB index has a much bigger valuation adjustment than MSCI EM and MSCI ESG EM. This is because the PAB index does not include the energy sector, which is present in both the ESG and traditional indices. The energy sector had high valuations in 2022 compared to the median, which increased the current PE ratio of indices with more energy exposure. This leads to a smaller valuation adjustment.

[6] https://www.dws.com/en-gb/insights/global-research-institute/dws-long-view-20210225/

[7] https://www.dws.com/en-gb/insights/global-research-institute/dws-long-view-2022/

Notes

We used standard market indices for the traditional indices as well on the ESG side. All indices are representative, investible via ETFs, liquid, and transparent. The inclusion of PAB indices in our framework may help investors who are focused on climate ESG metrics. For US sovereigns we apply a conservative approach and do not replace this portfolio share for the ESG optimisation. For investors applying ESG exclusion criteria for certain sovereigns, US sovereigns might be replaced by USD-denominated foreign sovereigns, USD-denominated Investment Grade Corporate bonds, or ideally by USD-denominated Supranationals. The latter would come closest in terms of the classical bond rating profile. It would also significantly uplift the ESG and SDG performance while ensuring comparable yield, rating, and currency exposure. Switching to other SRI/ESG ETFs for equities and corporate bonds may further improve the ESG data and carbon efficiency of the overall allocation. As demonstrated in the Case Study Section our approach is very flexible. This also includes, among others, the index set (see *Figure 23*)

Controversial sectors. Definitions of controversial sectors are fluent and context dependent. For this analysis we included Nuclear Power, Nuclear Weapons, and Tobacco.

Assessment F. This represents the share of the worst ESG performers and aggregates all F Assessments (Scale A-F) for Climate Transition Risks ("CTR"), the UN Global Compact ("UNGC") Norm Ratings as well as all F-graded securities based on the DWS ESG Quality Assessment.

Assessment E. This represents the share of the second worst ESG performers and aggregates all E Assessments (Scale A-F) for Climate Transition Risks ("CTR"), the UN Global Compact ("UNGC") Norm Ratings as well as all E-graded securities based on the DWS ESG Quality Assessment.

Assessments AB's. This contains the aggregated share of potential solutions provider. It represents the share of A- and B-graded securities for the DWS SDG-Assessment and the DWS CTR-Assessment.

Carbon Scope 1+2 Intensity/Carbon Scope 1+2+3 Intensity (adj). A company's carbon intensity is its total carbon emissions divided by the total revenues (tons CO2 per mln USD revenue). For a portfolio of company holdings, we calculate the weighted average of these intensities. We calculate the carbon emissions intensity as 1) a basic intensity of Scope 1 and 2 emissions like also suggested by The Institutional Investors Group on Climate Change (IIGCC) and 2) as an impact adjusted footprint, which also incorporates Scope 3 Emissions and avoided emissions. According to the GHG Protocol Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of a company, including both upstream and downstream emissions.

Carbon reductions for Scope 1, 2 and 3 emissions on Enterprise Value (EV) basis above 30% are potentially aligned with the EU Carbon Transitions Benchmark (CTB). Reductions above 50% would be potentially considered EU Paris COP Agreement aligned (PAB). Provided that the reference universes match the asset allocation of investors and the other EU Carbon benchmark criteria are fulfilled some optimisations could therefore be EU carbon benchmark aligned. However, to increase data consistency we used the revenue intensity instead of the EU EV-apportioning factor for the carbon footprint. Moreover, we adjust the Scope 3 emissions additionally by avoided emissions. Individual carbon reduction targets of companies like their participation in the Science Based Targets initiative are not assessed due to the still insufficient data coverage.

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