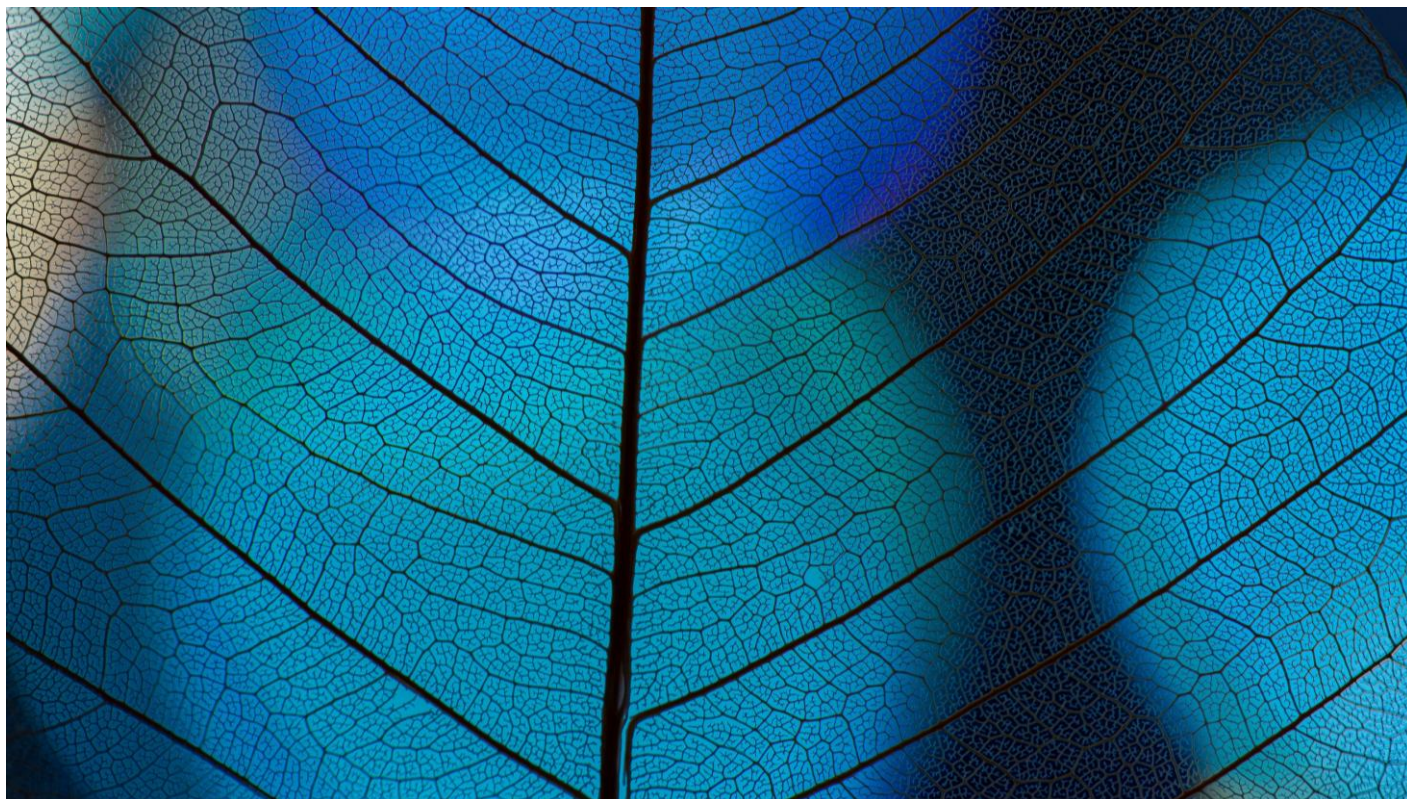




Index Research and Design | Multi-Asset

Tilting vs optimisation in the context of EU climate benchmarks

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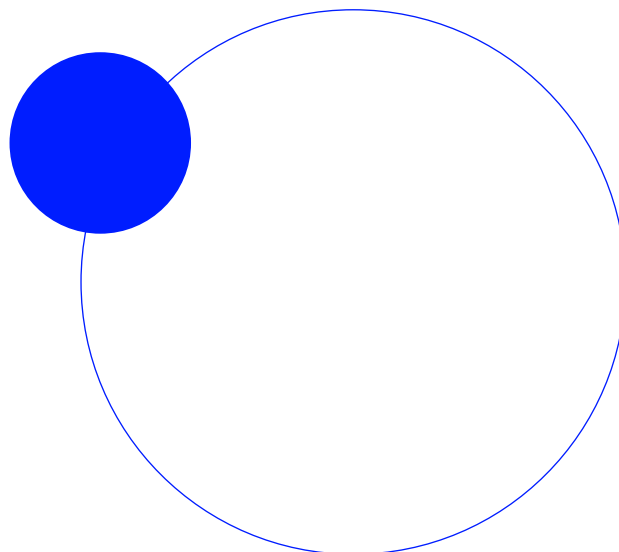
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Setting the stage: Why methodology matters

The way indices are built directly influences their performance, characteristics, and reliability. In this paper, we discuss the suitability of different index construction methodologies to meet the requirements of an EU Paris-Aligned Benchmark. In our research, we considered three different index construction methodologies: tilting, tracking error minimisation and turnover minimisation. We found that despite the relatively prescriptive requirements for a Paris-Aligned Benchmark, the index construction techniques yielded very different solutions, both in terms of technical characteristics (such as tracking error, concentration, turnover and liquidity); and qualitative outcomes (such as robustness and explainability).



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The context: The EU climate benchmarks

The EU Climate Benchmarks are a regulatory framework introduced by the European Union. The framework which aims to align investment objectives with climate objectives by enforcing decarbonisation trajectories, exclusion criteria, and minimum standards for greenhouse gas (GHG) emission reductions. EU climate benchmarks are intended to support the transition to a low-carbon economy and to enhance transparency and comparability in climate-related investment strategies.

In our research, we focused on the FTSE Developed EU Paris-Aligned (PAB) index, a global equity index within the FTSE EU Climate Benchmarks Index Series. In this index series the weights of constituents vary to account for risks and opportunities associated with the transition to a low carbon economy. The FTSE Developed EU Paris-Aligned (PAB) index's methodology is aligned with the minimum standards for EU Low Carbon Benchmark Requirements and supports investors' decarbonisation and net zero strategies.

More detail about the FTSE Developed EU Paris-Aligned (PAB) Index can be found [FTSE EU Climate Benchmarks Index Series](#).

More detail about the EU Low Carbon Benchmark Requirements can be found [COMMISSION DELEGATED REGULATION \(EU\) 2020/1818](#).

Figure 1: FTSE Paris-Aligned benchmark index design

Requirement	Index objective
Exclusions	Standard exclusion list + I CP not aligned stocks
Scope 1 and 2 emissions	50% reduction vs. benchmark and 7% YoY reduction
Scope 3 emissions	> 50% reduction vs. benchmark and 7% YoY reduction
TPI MQ	Uplift of 0.2 standard deviations vs. benchmark
TPI CP	Fixed tilt 1 or Uplift of 0.2 standard deviations vs. benchmark
Green revenue	Uplift of 100% vs. benchmark
Fossil fuel reserve	50% reduction vs. benchmark
High impact sector	Neutral
Industry/country	± 5% vs. benchmark
Capacity limit	20
Max weight	5%
Minimum weight	0.5bps
Effective N	No less than 25% of the benchmark

Source: Index Research and Design, FTSE Russell, October 2025.

Methodology choices

Target exposure¹ and optimisation are two well-established index construction methodologies. In brief:

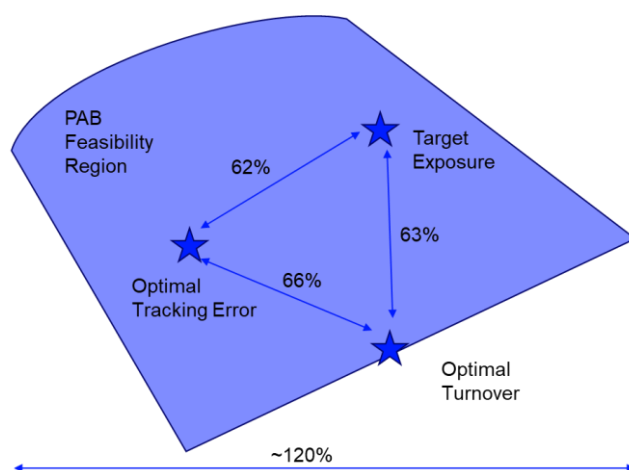
- Target exposure starts with the market capitalisation weights and tilts them subsequently towards stocks with favourable characteristics to achieve the index objectives, subject to a set of constraints
- Optimisation involves defining a utility function (e.g. tracking error or turnover) and solving for the index weights that optimise this function while satisfying the same set of objectives and constraints

For our analysis, we constructed indices meeting the FTSE Developed PAB criteria using the following techniques:

- Target exposure
- Tracking error minimisation
- Turnover minimisation

Given the complexity of the EU Climate Benchmark requirements, one might expect the target exposure and optimisation index construction methods to produce similar outcomes. However, our analysis revealed a broad feasibility set; we observed up to a 120% difference in feasible index weights². Within this feasibility set, the target exposure and optimised approaches were about 60% away from each other, underscoring the variability introduced by different index construction techniques³.

Figure 2: Visual representation of the solution space



Source: Index Research and Design, FTSE Russell, October 2025.

¹ Tilt-based solution. More details in [Target Exposure: Investment applications and solutions](#).

² We obtain the feasibility region by randomly generating index weights and performing turnover minimisation solving for PAB constraints and minimising the turnover against the random index weights. The resulting index lies on the feasibility boundary. We repeat the process 1,000 times to get a good coverage of the feasibility region.

³ This is not mathematically unexpected, as the optimisation solves a problem approximately the same number of degrees of freedom as the number of constituents in the universe. By contrast, the Target Exposure is solving a form of the problem with orders of magnitude fewer degrees of freedom.

This means that the choice of index methodology will be driven as to which solution to target is less by the overall feasibility and more by auxiliary objectives, such as low tracking error, turnover, transparency or robustness. We will contrast these outcomes in the next sections.

Outcomes

Although they achieved the same targeted sustainability outcomes, the three indices did so in substantially different ways.

The target exposure methodology required the lowest amount of leverage⁴. While all three methodologies had a constraint on individual stocks capacity ratio (maximum leverage of 20x) to ensure that weights in smaller, less liquid stocks were not outsized; Tracking error optimisation and turnover optimisation indices reached the boundary of this constraint (with maximum leverage of 20x). Target exposure remained well within the constraint (with maximum leverage of 10x). This translated into higher liquidity in the target exposure index.

The benefits of optimised solutions are well documented in academic and financial practitioner literature; they enable the simultaneous achievement of multiple objectives by incorporating them as constraints within the optimisation process and provide the best possible trade off relative to the metric of interest.

As expected, the tracking error optimisation approach delivered the lowest tracking error (roughly half that of the target exposure). This approach also results in the most diversified portfolio, as measured by the effective number of stocks, due to its focus on an optimal distribution of risk.

The lowest turnover of 9% was achieved by the turnover optimisation. By comparison, target exposure has had three times higher turnover (albeit in larger, more liquid stocks based on the leverage figures), while the tracking error optimised solution had four times higher turnover.

Figure 3: Index statistics

Stats	Effective N % BM	Universe Coverage	Tracking Error	Max Leverage	Average Leverage	Turnover 2-way
Target Exposure	48%	54%	2.3%	10x	1.75x	27%
Tracking Error Optimisation	90%	40%	1.2%	20x	3.24x	40%
Turnover Optimisation	55%	49%	1.9%	20x	4.84x	9%

Source: Index Research and Design, FTSE Russell, October 2025.

⁴ Effective N % BM is the effective number of stocks expressed as percentage of the underlying benchmark's effective number of stocks. Effective number of stocks is the diversification measure expressed as equivalent number of equally weighted stocks. Universe Coverage – percent of the universe stocks with non-zero weights. Tracking Error is based on FTSE/Russell proprietary risk mode. Max and average leverage are the maximum and average ratios of index weights over benchmark weights. Turnover 2-way – is the average turnover of the index on the annual review dates.

Some of the less desirable characteristics of the index methodologies can be addressed through the introduction of additional constraints, such as limits on turnover, tracking error, the effective number of stocks or leverage. For example, by applying a turnover constraint to the tracking error optimised index, we were able to significantly reduce turnover at the expense of a marginally higher index concentration level. The solution also moved closer to the turnover optimised index, as measured by the sum of absolute weight differences.

Figure 4: Index statistics for tracking error optimisation variants

Stats	Effective N % BM	Universe coverage	Tracking error	Max leverage	Average leverage	Turnover 2-way
Original	90%	40%	1.2%	20x	3.24x	40%
+ 30% Max turnover	88%	40%	1.2%	20x	3.14x	28%
+ 20% Max turnover	85%	40%	1.2%	20x	3.18x	20%

Source: Index Research and Design, FTSE Russell, October 2025.

Similarly, by introducing a 10% marginal tracking error contribution constraint to the target exposure methodology, we saw a notable (approximately 25%) reduction in tracking error, and the solution moved half-way to that of the tracking error optimised index.

Index robustness

The comparison of the index outcomes would be incomplete if we did not include the robustness and explainability as part of the discussion.

In our recent publication [Robust index design: The case for sensitivity-aware methodologies](#) we introduced a practical test for assessing index robustness. The idea is simple: if small changes in input data lead to large shifts in index composition, the methodology may be overly sensitive (i.e. not robust).

To illustrate this, we focused on Scope 3 Emissions Intensity, a metric known to carry a relatively high (around 20%) margin of estimation error, as discussed in [Scope for improvement](#). By introducing 20% random noise to the input data, we simulate a realistic variation in Scope 3 figures. We then rebuilt the indices using the "noisy" data and compared the resulting weights to those of the original index. Repeating this process 500 times allowed us to measure the sensitivity of each methodology to data uncertainty.

Our findings, shown in Figure 5, found that the target exposure index was notably more resilient to input noise than the tracking error optimisation index.

Figure 5: Sensitivity of target exposure vs. tracking error optimisation to 20% noise on Scope 3 emissions intensity



Source: Index Research and Design, FTSE Russell, October 2025.

Tracking error optimisation is also highly sensitive to the choice of risk model. As shown in Figure 6, changing the covariance inputs, such as using daily rather than weekly data or varying the lookback window, can lead to portfolio weight differences of up to 33%, highlighting the extent of risk model dependency.

Figure 6: Differences between tracking error optimised indices constructed with different risk models

Risk Model	5 years, weekly	3 years, weekly	3 years, daily
5 years, weekly	0%	20%	32%
3 years, weekly	20%	0%	33%
3 years, daily	32%	33%	0%

Source: Index Research and Design, FTSE Russell, October 2025.

Overall, these sensitivities highlighted the relative robustness of the target exposure methodology over the tracking error optimisation version.

Index transparency

Another key consideration is the explainability of a constituent's weight in an index. While optimisation across any set of chosen parameters creates a black box for how the final weighting is determined, target exposure provides transparent weighting based on the scores and relative tilts assigned to each stock. If communication and interpretability of

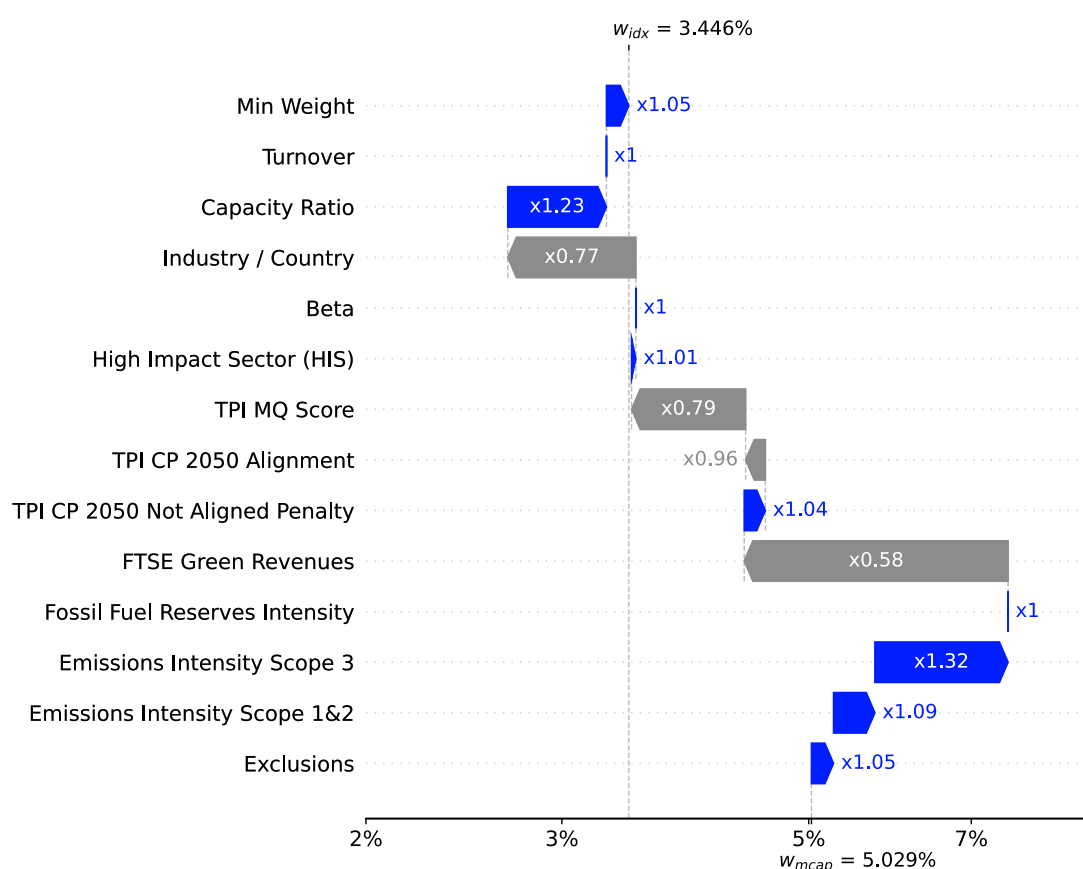
relative stock positions is important, this will be a key driver in index construction decisions.

Waterfall charts serve as a powerful visual tool in this context, offering a clear representation of how various factors contribute to a stock's relative position within an index. By illustrating the cumulative effect of different drivers, they enable us to quickly assess the key elements influencing a stock's weight or inclusion in the index.

In Figure 7 we looked at Nvidia within the FTSE All-World Developed Paris-Aligned index as an example. It moved from a market capitalisation-based weight of just above 5% in the FTSE Developed index (as at the September 2025 review) to a final weight of 3.447%.

We work through the bars (from bottom to top) to understand the key drivers for this relative underweighting of the stock in the index. Nvidia benefitted from the redistribution of index weights from excluded companies, and it was rewarded for having relatively low greenhouse gas emissions compared to other constituents. However, it was penalised for having no green revenues, a lower Transition Pathway Initiative management quality ("TPI MQ Score"). It receives a negative tilt from the Industry/Country constraint as a result of the US Tech sector's overall overweight breaching the constraint limits. Finally, it gets a push from the Capacity constraints as the overweight in smaller stocks breaching the capacity limit is redistributed. Together, these adjustments led to an overall underweight position of Nvidia in the index (when compared with the capitalisation-weighted starting portfolio).

Figure 7: Weight explainer of Nvidia as of September 2025



Source: Index Research and Design, FTSE Russell, October 2025.

The level of transparency offered by the target exposure index approach therefore provides a crucial edge, offering clear insight into the detailed decisions and processes behind index construction. It empowers stakeholders to make more informed decisions and better assess how well the methodology delivers on its intended objectives.

Discover tailored solutions

Index construction methodology plays a critical role in shaping portfolio outcomes. While there are many potential approaches, each portfolio has unique design objectives that require tailored solutions.

At FTSE Russell, we support investors by providing:

- Insights into how methodology impacts traditional performance and risk metrics
- Analysis of methodology resilience and sensitivity under data volatility
- Tools for granular breakdowns to understand the effect of each objective

We work with clients to identify and implement index solutions aligned with their specific portfolio construction goals.

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