Research Insight

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Paris-Aligned Benchmarks in Practice

Insights into implementation

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Introduction

The Paris-Aligned Benchmark (PAB) requirements, formalized by the European Commission in 2020[1] (PAB Regulations), have seen widespread adoption by institutional investors seeking to align portfolios with the 1.5°C temperature goal set by the Paris Agreement and their own climate-risk-driven investment strategies. Their influence has gone far beyond public product indexes formally labelled "PAB" and has shaped climate-index rules for private mandates globally. Influenced by two years of industry-wide consultation,[2] the PAB framework includes a 50% cross-sectional reduction in greenhouse gas (GHG) intensity versus a relevant cap-weighted peer, a minimum 7% annual GHG intensity self-decarbonization trajectory, as well as environment-related exclusions and "core" sustainability screens. These requirements are combined with detailed index construction rules aimed at preserving exposure to specified High Climate Impact sectors (consistent with an economy-wide transition) while materially reducing emissions intensity.

The European Commission's introduction of minimum benchmark standards for qualification as EU PAB has supported their use in active and indexed investment strategies alike. Five years on, these standards have been used in many standalone climate indexes as well as those incorporating broader sustainability objectives or other key investment outcomes (factor and thematic exposures, for example). Nevertheless, implementing the methodology at scale has presented challenges. These include the availability, granularity and stability of input climate data, the interpretation and extent of exclusion criteria, and the feasibility of the prescribed decarbonization pathways.

In this research paper, we draw on MSCI's experience in designing and maintaining PAB indexes to examine these practical realities of implementation. Through a mixture of historical examples, simulation and scenario analysis, we illustrate how PAB standards need not hinder the achievement of the targeted index objectives, whether for global or regional equity universes. In particular, we find that even if real-world decarbonization continues to fall short of company and policy targets, the decarbonization requirements of PAB indexes linked to large regional or global benchmarks should be achievable through careful index construction and rebalancing.

[1] On December 3, 2020, the Commission Delegated Regulation 2020/1818 detailing minimum standards for EU Paris-Aligned Benchmarks (as well as the less constrained EU Climate Transition Benchmarks) was published in the Official Journal.

[2] The work of the Technical Expert Group (TEG) is summarized in their Final Report with frequently answered questions about their recommendations addressed in the Handbook for CTBs and PABs, last revised in 2025. The TEG group materials can be useful for context and original motivation. However, they are not binding, and we follow the final PAB Regulations in our index methodology.

A roadmap for analysis

Since their introduction in 2020, PAB standards have been increasingly integrated into investment strategies designed to be aligned with the Paris Agreement. Even with the detailed PAB regulatory criteria, the implemented index design involves finding a prudent balance between robust methodology, diversification and ongoing rebalance feasibility whatever the real-world input data limitations and changes. In this report, we provide a practical and implementation-focused view based on five years' experience of managing such PAB indexes across global and regional equity universes.

The key aspects of the analysis in this paper include:

- **Proxies ensure a comprehensive coverage of exclusions when definitions or data are limited**
  While exclusions of controversial weapons or tobacco involvement are straightforward, others — like the "Do-No-Significant-Harm" principle[3] — necessarily rely on proxies such as Environmental Controversies, due to the lack of consistent company-level EU Taxonomy reporting and practical barriers to being able to depend on the rigorous and error-free collection of such disclosures. Exclusions tied to fossil fuel revenues and power generation have also relied on modelling and technology-based proxies to maintain integrity, consistency and breadth of coverage.
- **Decarbonization through rebalancing supported by efficient turnover**
  The PAB's minimum 7% compounded annual GHG intensity decarbonization requirement has often been achieved through index turnover and weight reallocation toward lower-emitting (or less emission-intensive) firms. Given that many public companies lack targets while many others are on a pathway to overshoot their share of the remaining carbon budget consistent with limiting global temperature rise to 1.5°C, index rebalancing has played a larger role than actual corporate emission reductions. Empirical attribution analysis is used to confirm that index design, rather than real-world decarbonization, is the current key driver of intensity reduction.
- **Emissions stress-testing suggests feasibility for broad and regional indexes**
  We employ emissions reduction scenario-testing across a range of parent universes in developed markets (DM) and emerging markets (EM) to confirm that, at least for broader regions, PAB compliance for climate indexes could be maintained on future investment horizons of up to 10 years. In the absence of real economy decarbonization, higher self-decarbonization rates or, equivalently, longer investment horizons naturally led to narrower indexes and higher active risk in our simulations. However, those concentration or tracking error effects were relatively modest.
- **Consistent decarbonization pathways for new intensity baseline values are possible**
  Changes in emissions modeling, particularly for scope 3, can materially affect calculated index trajectories. We detail the MSCI approach to re-setting the reference baseline that uses consistent back-calculated data and how it is designed to ensure the integrity of decarbonization pathways over time and to mitigate associated greenwashing risks.

[3] As defined under Article 12(2) of PAB Regulations.

Rules and challenges

The minimum standards for the PAB designation include the following four key elements[4]:

- *Core sustainability exclusions* aligned with ex-controversial weapons, ex-tobacco-related businesses and ex-violators of OECD or UNGC guidelines,
- *Environmental exclusions* related to companies "doing-no-significant-harm" to the environmental objectives of the EU Taxonomy or based on limiting eligibility for companies involved in the fossil fuels value chain and/or carbon intensive power generation
- *Cross-sectional intensity decarbonization* of 50% relative to a relevant cap-weighted benchmark
- *Time-series self-decarbonization* relative to a comparable historic index level at a compounded rate of no less than 7% per annum,

all to be achieved while maintaining market-like exposure to the High Climate Impact sectors. In this paper, we examine the data and index construction challenges posed by complying with these rules, based on five years' experience in building PAB indexes.

While these requirements can be implemented in an index methodology without optimization, the MSCI EU PAB Overlay indexes[5] and other MSCI standard PAB-compliant indexes use optimization to more effectively and efficiently manage index exposures and minimize the tracking error experienced versus the cap-weighted reference. This approach facilitates more precise alignment with the PAB-based and other climate-based risk objectives while better managing key industry, regional and style characteristics versus the parent index.

Interpreting exclusions

Some mandatory PAB Article 12 sustainability exclusions[6] are unambiguous, such as involvement in tobacco cultivation and production, but others have required nuanced interpretation. The "Do-No-Significant-Harm" test references the EU Taxonomy without defining how to assess "significant harm" at the company level. As a proxy, MSCI uses MSCI ESG Environmental Controversies, which are based on media reports, corporate disclosures and other publicly available data sources. This assessment may lead to precautionary exclusions. For example, in Q1 2023, nearly half of the weight of the consumer staples sector for MSCI World Index was flagged due to issues related to single-use plastics. While this raised concerns about broader exclusion risks, our analysis has shown the chosen proxy supports overall index credibility. Granular approaches that screen specific harmful types of activity may be too narrow to

[4] For a more in-depth discussion of the application of the EU standard within index methodologies, see the MSCI EU CTB/PAB Index Framework, first published December 2024 and most recently updated in April 2025.

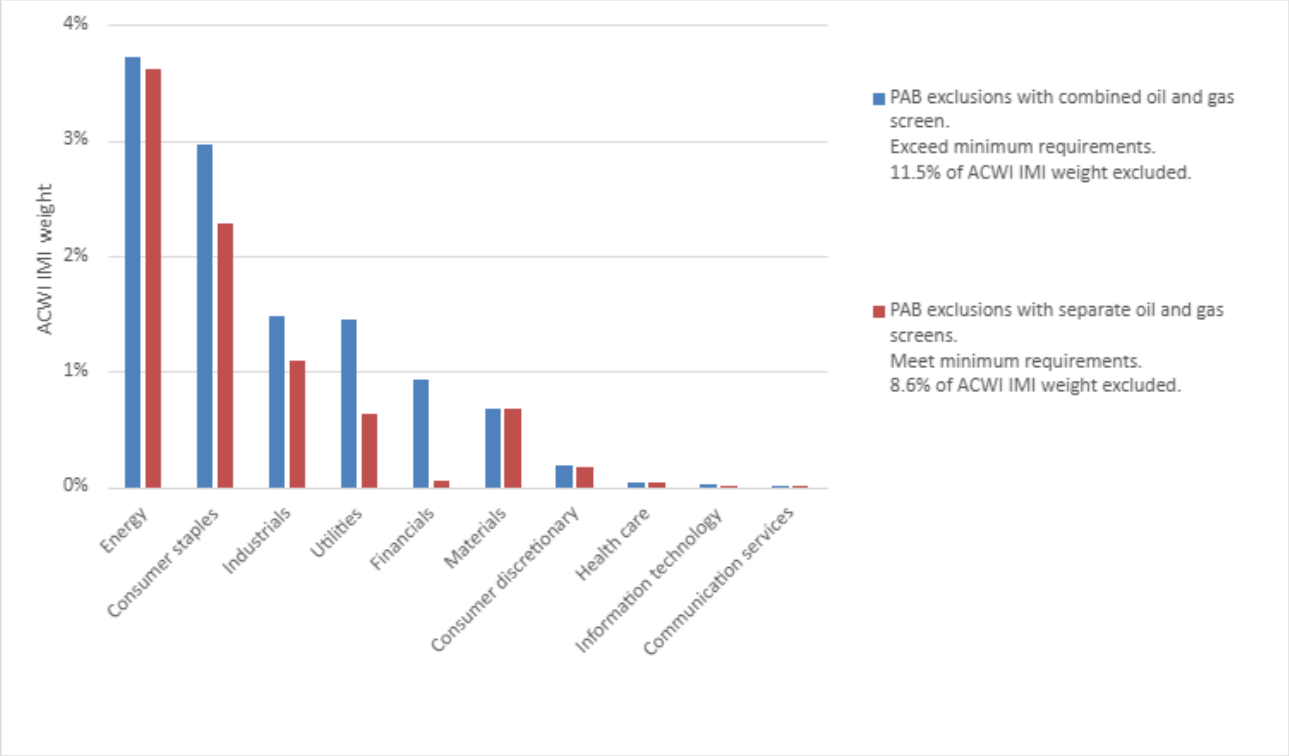
[5] We use the MSCI EU PAB Overlay Index methodology as representative of an index which seeks to implement the PAB requirements alone.

[6] Art. 12 of the Commission Delegated Regulation (EU) 2020/1818.

address the full scope of the Do-No-Significant-Harm (DNSH) test and more fragile in practice as input data. Some structural tilts against sectors with high environmental impact (e.g., energy, industrials, materials) have always been likely under the PAB Regulations. Further harmonization of the DNSH interpretation would require stronger alignment across market participants.

The exclusions for oil- and gas-related activities address specific parts of the fossil fuel value chain (no more than 1% revenue from thermal coal etc.). Companies do not always report separate revenues between oil and gas and may aggregate across the value chain. We have used estimates to complement granular disclosures to better target the mandated exclusions. The chart below shows that using the most granular oil and gas screens introduced in Q4 2024 can improve index coverage and feasibility especially for utilities, industrials and consumer staples. On the other hand, indexes with stricter climate objectives retain flexibility to exclude broader fossil fuel related activities beyond those explicitly mandated by the regulation. MSCI's standard PAB index implementation currently uses the combined oil and gas screen on a precautionary basis, i.e., a 10% threshold is applied to the aggregate revenue from oil- and gas-related activities.

PAB exclusions weight impact: separate versus combined oil & gas screens



Data as of Feb. 28, 2025. The separate screens apply a 10% threshold for oil-related revenues and a 50% threshold for gas. A combined oil and gas screen approach would exceed minimum requirements by applying a 10% aggregate threshold which may also capture activities not listed in the regulation, such as retail, equipment and services.

The PAB rules require the exclusion of companies that derive 50% or more of their revenues from electricity generation with a GHG intensity of more than 100 g CO2 e/kWh. However, companies typically

provide only aggregate data for emissions, power generation and revenues. To estimate the share of revenues exceeding the above threshold, MSCI uses power generation technology as a proxy. Based on data from the Intergovernmental Panel on Climate Change (IPCC),[7] thermal coal-based power generation, liquid fuel-based power generation and natural gas-based power generation have typical lifecycle emissions exceeding 100 g CO2 e/kWh. Since the breakdown of power generation revenues by technology is readily available, this approach has provided a simple, robust and explainable implementation of the regulatory screen.

Decarbonizing over the years

The defining 7% annual self-decarbonization can be achieved either by the underlying constituents reducing their emissions (as measured by the index weighted-average enterprise intensity) or by index turnover towards lower-intensity emitters. The latter route is key when more than 85% of the world's public companies have an implied temperature rise (ITR) of above 1.5°C. It is thus challenging to make a diversified benchmark where each constituent is expected to be currently "Paris-aligned" or to meet the PAB decarbonization requirements. Moreover, in recent years the GHG intensity of many investable universes did not decrease at nearly the required pace. Without that index turnover, the methodology could not be considered aligned with the 1.5°C pathway for the Paris Agreement.

To make this concrete, we look at the emission intensity attribution analysis below that highlights the decarbonization progress of the MSCI ACWI EU PAB Overlay Index since December 2023, compared to that of MSCI ACWI Index.[8] The chart quantifies how the reduction in emission intensity for the PAB index was driven primarily by "divestment" (that is, index rebalance deletions) and index rebalancing (index additions or changes in index weights that favor lower-emitting companies). The index methodology uses optimization to adjust weights with the aim of reducing emissions intensity while controlling misalignment with risk dimensions of the underlying investment universe (by control of index TE). As a result, most of the decarbonization comes from shifts in weights and composition rather than from improvements in company-level emissions, labelled in the chart as "organic decarbonization".

Note that the figures shown in this attribution are "raw" in the sense that they are unadjusted for market-wide changes in EVIC (the denominator in the GHG intensity). EVIC provides a scale suitable for a wide range of issuers with different capital structures. However, without a year-on-year re-adjustment, as described in Article 7(3) of the PAB Regulations, an index could be considered as decarbonizing just because equity markets had rallied. Analyzing the relative sources of reduction in the figure remains informative.

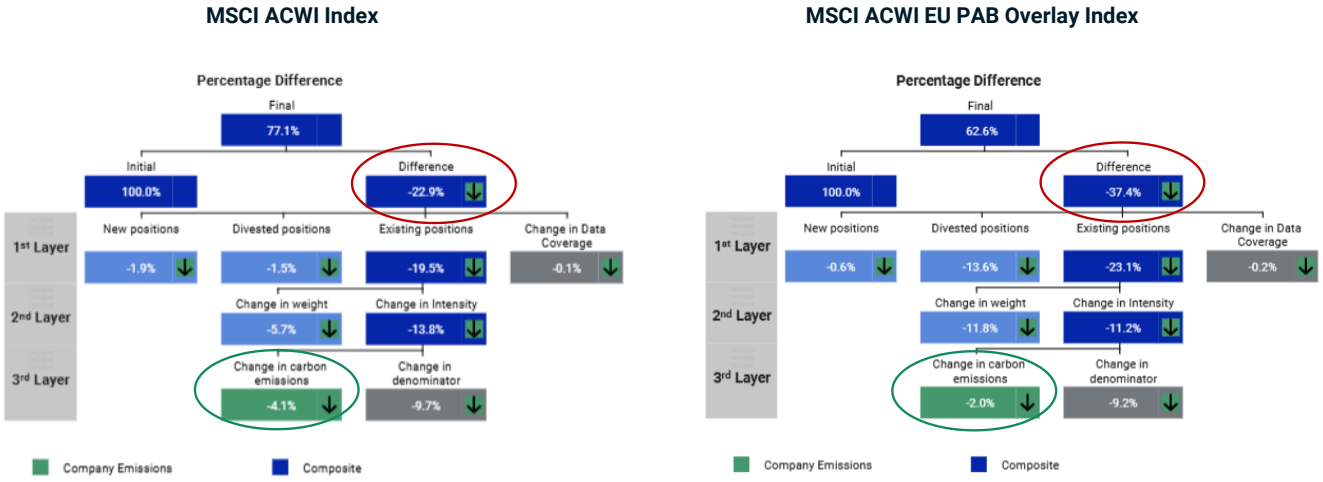
In contrast, fundamental emissions reductions — actual company-level decarbonization — played a more limited role over the period. This underscores the importance of the index rebalancing rules for aligning with a decarbonization trajectory if the broader economy is not decarbonizing at the required

[7] See, for example, Chapter 7 on Energy Systems in the Working Group III's contribution to the IPCC's Fifth Assessment Report.

[8] The approach follows the 2023 MSCI-authored paper "A Framework for Attributing Changes in Portfolio Carbon Footprint" by Nagy et al. , Journal of Portfolio Management 49, no. 8, pp. 163–184 .

pace. That said, the analysis demonstrated the index methodology has been functioning as intended. The PAB index has achieved substantial emissions intensity reductions since inception (7% year-on-year with EVIC "inflation" adjustment) while delivering a 50% cut relative to its parent index (irrespective of whether those emissions have risen or fallen). Moreover, if the index *already* includes many carbon-efficient companies in each sector then reduction by further "organic" decarbonization at the company level within the index is more difficult.

Attribution of raw decarbonization of the MSCI ACWI EU PAB Overlay Index



Change in carbon emissions intensity from 31 Dec. 2023, to 30 April 2025, for MSCI ACWI Index and MSCI ACWI EU PAB Overlay Index. The MSCI ACWI EU PAB Overlay Index applies a minimum 7% self-decarbonization to index intensities adjusted each year for EVIC-inflation.

Scenario analysis to evaluate future robustness

This shortfall by corporates means meeting the decarbonization target over time could potentially lead to index TE and concentration levels exceeding historic levels, or client expectations. To assess this risk, we created a sequence of relatively conservative three, five, seven and 10-year "forward" simulations for which the parent index had the same constituents throughout and no company emissions intensity reductions occurred.[9] We evaluated the impact on TE and concentration in particular for the 7% self-decarbonization rate. We used a range of parent indexes — the MSCI World, MSCI Emerging Markets and MSCI EMU Indexes — to also test the effect of concentration in the reference parent index.

On the positive side, all the index simulations remained feasible and PAB compliant in all configurations. However, as expected, in the absence of company-level emissions intensity reductions, the active risk generally increased for all investment universes as the decarbonization time horizon was extended. By

[9] The assumption of no emissions intensity reduction at all over the 10-year period is relatively conservative. However, emissions intensity could continue to rise, and we have factored in no special events like a pandemic or market crises that could impact calculations and risk estimates significantly.

construction, all decarbonization had to be achieved via index rebalancing alone, which tended to increase portfolio deviation from the parent index. Although all TE increases were relatively modest, the EM simulation exhibited the largest rise on account of its higher carbon intensity as well the specifics of market structure and sector distribution, which limited flexibility when rebalancing to meet emissions targets. For all strategies, increases in TE and concentration were more marked after five years.

Decarbonization stress-test analysis for select simulated MSCI EU PAB Overlay Indexes over a range of calculation horizons

Metrics	MSCI World Index (As of Dec 3, 2024)	MSCI World EU PAB Overlay Index (As of Dec 3, 2024)	MSCI World EU PAB Overlay Index (3 years)	MSCI World EU PAB Overlay Index (5 years)	MSCI World EU PAB Overlay Index (7 years)	MSCI World EU PAB Overlay Index (10 years)
Active Risk (%)		0.75	0.84	0.91	1.00	1.18
Number of Constituents		943	851	760	673	532
Mcap Coverage (%)		81.9%	78.9%	75.9%	72.3%	64.0%
S123 Intensity (Wtd Avg tCO2e/$M EVIC)	299.0	85.2	68.5	59.3	51.3	41.2

Metrics	MSCI EM Index (As of Dec 3, 2024)	MSCI EM EU PAB Overlay Index (As of Dec 3, 2024)	MSCI EM EU PAB Overlay Index (3 years)	MSCI EM EU PAB Overlay Index (5 years)	MSCI EM EU PAB Overlay Index (7 years)	MSCI EM EU PAB Overlay Index (10 years)
Active Risk (%)		0.73	0.87	1.00	1.13	1.43
Number of Constituents		774	646	601	552	455
Mcap Coverage (%)		83.0%	78.3%	76.3%	71.9%	63.3%
S123 Intensity (Wtd Avg tCO2e/$M EVIC)	565.9	147.4	118.6	102.6	88.7	71.4

Metrics	MSCI EMU Index (As of Dec 3, 2024)	MSCI EMU EU PAB Overlay Index (As of Dec 3, 2024)	MSCI EMU EU PAB Overlay Index (3 years)	MSCI EMU EU PAB Overlay Index (5 years)	MSCI EMU EU PAB Overlay Index (7 years)	MSCI EMU EU PAB Overlay Index (10 years)
Active Risk (%)		1.08	1.24	1.34	1.45	1.64
Number of Constituents		179	173	165	158	142
Mcap Coverage (%)		85.4%	84.4%	81.7%	78.3%	71.6%
S123 Intensity (Wtd Avg tCO2e/$M EVIC)	514.8	178.6	143.6	124.2	107.5	86.4

Index data as of Dec. 3, 2024. The three-, five-, seven- and 10-year simulations take the Nov. 2024 index review as the base reference and model the effect of applying 7% annual self-decarbonization targets over three, five, seven and 10-year periods for each equity universe. All other data is unchanged including constituent-level emissions intensity (i.e., no organic decarbonization) and static parent index composition.

We should emphasize that these conclusions on ongoing feasibility also rely on the application of the PAB index rules to large regions or broad markets. Similar experiments applied to individual European countries typically experience problems with feasibility beyond year seven, even if small caps are included for breadth. Infeasibility may persist even with the constraint relaxation prescribed in the EU PAB Overlay Index methodology. These single country strategies are typically much higher TE at the outset (around 3%). Similarly, indexed strategies where PAB rules are combined with other sustainability or factor exposure outcomes also may experience infeasibility for longer horizons.

If organic decarbonization, i.e., emissions intensity reductions by companies through their own actions, were observed then there would be less reliance on rebalancing to meet the self-decarbonization targets and hence better diversification and lower TE than calculated. The overall decarbonization achieved by

an index is a combination of constituent-level improvements and index-level adjustments. The table below shows arithmetically how we can consider the calculated scenarios above as equivalent to the other combinations of annual decarbonization rate and time horizon. For example, a 7% annual reduction for seven years is an equivalent scenario to a 5% annual target over 10 years or a 10% rate over 5 years.

Comparing decarbonization scenarios via remaining index-level intensity

Annual self-decarbonization	3 years	5 years	7 years	10 years
5%	86%	77%	70%	60%
7%	80%	70%	60%	48%
10%	73%	59%	48%	35%

Cumulative emissions intensity reduction shown as the remaining emissions intensity as a percentage of the starting level.

Re-setting the clock?

A historical index GHG intensity trajectory can mask the complexity of the underlying emissions data in terms of data timing (disclosure, model incorporation) as well as the influence of scope 3 emissions. Unlike scope 1 and 2 emissions which typically rely on company disclosures (of their own model outputs), most scope 3 data used in indexes rely on market-wide modelling by climate data providers since companies' own scope 3 estimates are based on such disparate methodologies. That leaves year-on-year intensity constraints vulnerable to not only large corporate variation (companies change, and change their processes, and moreover, operate through profound dislocations like the COVID-19 pandemic) but also to enhancements to the external scope 3 estimation methodology.

The challenge of the fixed decarbonization target independent of companies' actual emissions trajectories, inherent to the PAB rules, is thus amplified by methodology changes that may have significant effects on certain countries or industries. The companies may not be changing fundamentally, but at what stage do changes in the emissions calculation or estimation methodology warrant a re-basing for the decarbonization trajectory? The PAB rules recognize the need to do this[10] but a rigorous process is required to mitigate potential greenwashing concerns and help preserve product integrity and consistency. Following a recent consultation, MSCI announced it will now handle these concerns by detailing the exact criteria used to entertain such a change in index methodology books. Moreover, the MSCI PAB indexes will now take advantage of the newly available back-calculated MSCI climate model data to create a new but consistent five-year decarbonization trajectory leading to the re-base date. The exhibit below illustrates how this would look at the parent index level by comparing the evolution for the MSCI World Index with the like-for-like calculation (historic data, same estimation model).

[10] The base reset is discussed in Article 8(2) of Commission Delegated Regulation (EU) 2020/1818.

Emissions intensity trajectory of MSCI World – historical and recalculated data

Emissions intensity data calculations between June 2021 and Dec. 2024 compares point-in-time emissions intensity at index-level with recalculated intensities using back-populated scope 3 data using current scope 3 data methodology.

Conclusion: Staying on the pathway

PAB indexes, along with other strategies using self-decarbonization, reflect multi-dimensional investment strategies that require careful analysis and research to implement in practice, in a way that maintains real world investability and feasibility for portfolio managers. In this paper, we have illustrated how MSCI effected this blend of practical index construction with regulatory alignment to achieve the required climate risk outcomes, despite volatile markets and the rapid evolution of climate data gathering, modelling and reporting. Nevertheless, future developments in climate investing and the underlying climate science require such implementation approaches to continue to be closely monitored for efficacy, flexibility and robustness.

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