Scientific Climate **Indices**
An EDHEC Venture

How Much Tracking Error Does Climate Ambition Really Cost?

Episode 1: Tilting versus risk model-based approaches

October 2026



SciX
An EDHEC Venture

Institutional investors pursue climate-aware equity strategies for a variety of objectives. Some are mandated to decarbonise in line with the Paris Agreement; some seek to reduce climate transition risks or physical risks within the portfolio; some wish to contribute proactively to change by investing in companies that engage in climate solutions. Whatever the goal, one aspect is always present: investors must deviate from the benchmark, introducing tracking error for market participants whose risk budget is often explicitly defined in **tracking error** terms and intrinsically linked to fiduciary commitments.

Yet balancing the twin goals of tracking error and climate outcomes in **live** climate-aware equity portfolios (as opposed to convenient back-tests) is no easy task. An index adjusted to deliver a certain climate-related objective might have produced a particular average tracking error over a historic period, but the deviation could be very different going forwards. Conversely, portfolios that simply prioritise tracking error can leave climate goals under-achieved and ungovernable.

How can investors navigate this challenge? In this note, we compare two approaches: *portfolio tilting*, a methodology that is widely used across the climate indexation sector, versus using a risk model to target *an ex-ante level of tracking error*. (In the interests of making our bias transparent, the latter is the approach used by SciX indices.)

Key takeaways:

- **A classic 'tilting' methodology can result in over- or under-use of the tracking error budget for long periods of time** due to its reliance on historic data – a problem illustrated starkly through the regime shifts of the 2020s.
- **This over- or under-use of tracking error in a tilting approach can also lead to sub-optimal delivery of climate objectives**, since the risk budget is often not fully used. Ideally, an investor will wish to deploy the full tracking error available to deliver the relevant climate goals.
- An alternative 'risk model' methodology can materially address both of these problems, as illustrated by the data shown in this article. In addition, it can further improve the **efficiency with which an investor can deliver climate goals** due to its ability to consider stock-level heterogeneity in terms of active risk.

The tilting method: transparent but too simple?

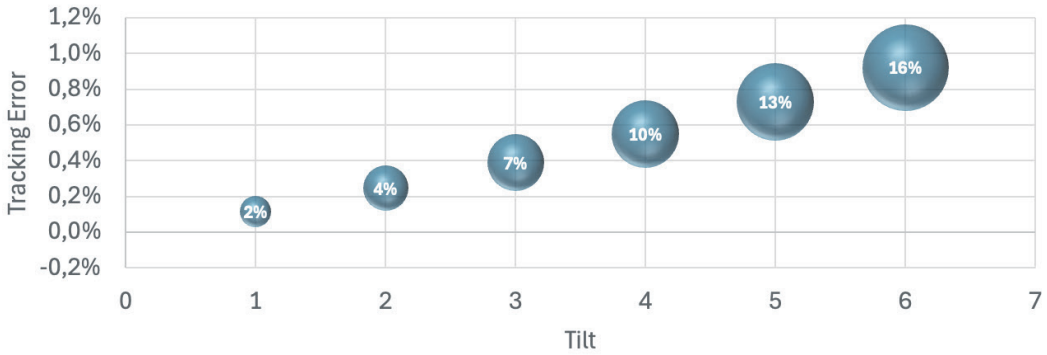
The tilting approach is commonly applied in the investment industry to build climate equity strategies. Its attractions are obvious: it is a straightforward route to implement weight deviations from the reference benchmark that is both intuitive and simple to explain.

In a nutshell, companies with a good climate score[1] are overweighted relative to their weight in the reference benchmark, while companies with a poor climate score are underweighted. The deviation from the market cap benchmark (and hence the tracking error) are driven by the climate score and the intensity of the tilt: the stronger the tilt, the bigger the tracking error. The tilt can be adjusted to ensure sector neutrality or region neutrality, though not both simultaneously. Imposing a sector or country constraint will, consequently, **reduce the expected tracking error** for a given tilt, while also **reducing the climate ambition** of the implemented strategy, as illustrated in Exhibit 1.[2]

1 - The climate score can be based on one metric, such as carbon intensity, or a blend of different climate metrics. Using a blend of climate metrics for the score can lead to a problem known as dilution that we are not going to cover in this note.

2 - The relationship between tracking error and the climate score is linear in this example as we used a linear tilting formula. In practice, investment professionals can also use an exponential tilting formula, hence the relationship between tracking error and the climate score would be exponential, but this would not change the mechanics of the tilting approach.

Exhibit 1: Average tracking error and climate physical loss reduction of climate-tilted strategies



Source: SciX. This chart shows the annualised tracking error and average quarterly physical loss reduction of different climate-tilted strategies from June 2004 to June 2026. The tracking error is computed using daily USD total returns. The size of the bubbles is proportional to the climate physical loss reduction relative to the benchmark. The climate-tilted strategies use the SciX Developed index as the benchmark for the tilting. The climate score is a physical climate loss developed in collaboration with the EDHEC Climate Institute. The tilting is done as follows: $w_i(1+tilt \times s_i)$ where tilt can be 1, 2, 3, 4, 5 or 6, w_i is the weight of stock i in the benchmark and s_i is the physical climate score. Weights are then normalised to sum up to 100%. The weighting is applied every quarter.

The choice of the tilt for an investor is then quite straightforward, in theory: the investor knows their tracking error budget and picks the tilt that corresponds to that number. For instance, a 0.5% tracking error budget would lead to the selection of the 'tilt 4' budget with an historical tracking error of 0.55%. Yet this simplicity and transparency hide **two serious limitations.**

The first problem is that investors can end up **over- or under-spending their tracking error budget for a long time** after making their investment decision – especially amid shifts in market regime. Why? There is no reason to assume that historical tracking error implied by a given tilt is a good proxy for future tracking error. An investor making an investment decision in 2016 would have picked a different tilt than in 2026 or in 2008 to be in line with his risk budget. Advocates would argue that the intensity of the tilt defines the average weight deviation from the benchmark, or active share, which is a proxy for tracking error[3]. Yet this argument assumes that active risk is homogeneous across stocks and across market conditions, which is not the case. As we see in Exhibit 2, the average tracking error can hide large short-term variations and different levels through time.

Exhibit 2: Six-month rolling tracking error for different climate tilted strategies

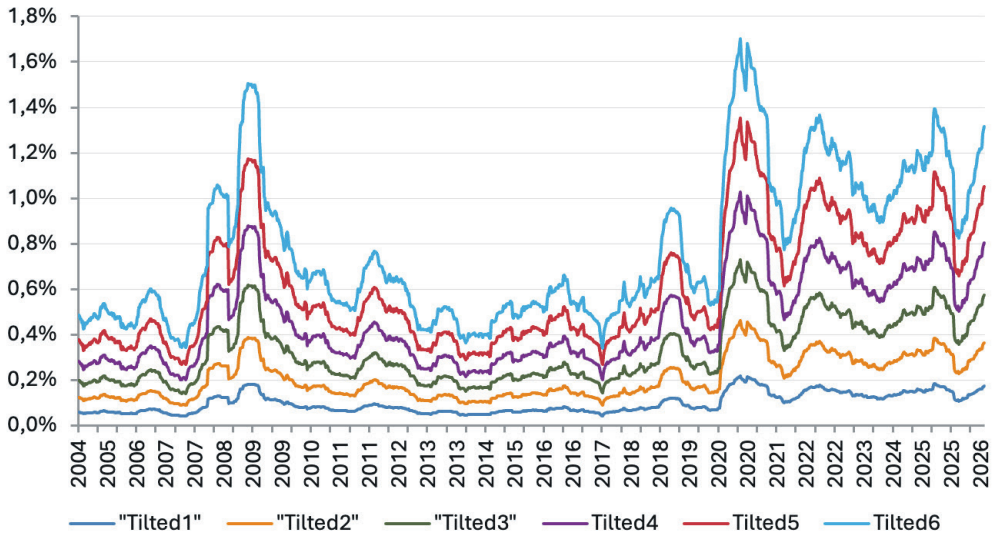


Exhibit 2 represents the 6-month rolling tracking error of climate tilted strategies as defined in Exhibit 1. The rolling tracking error is measured with weekly steps and annualised.

3 - This question will be treated in a future SciX Insights.

The second limitation of the tilting approach lies in its **inefficiency in delivering investors' climate objectives**. Investors aim to maximize their climate goals, as measured by a climate score, per unit of active risk or tracking error. As such, they wish to consume their risk budget fully in order to pursue those climate deliverables. Indeed, in an ideal world, one could go even further on this aspect – as discussed below.

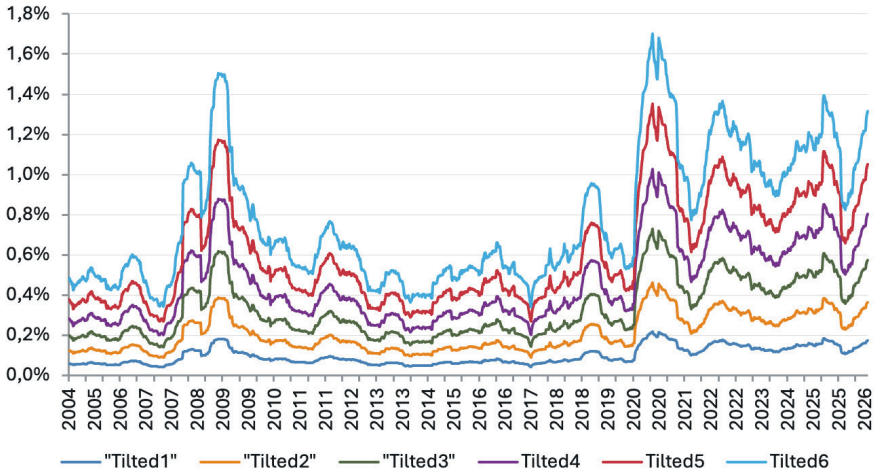
The risk-model method: a better alternative?

A risk model enables the robust estimation of stock-level active risks that can be used to make ex-ante allocation decisions on stocks with a specific risk objective, such as minimizing or targeting a specific level of tracking error while targeting climate objectives. Stocks' weights can be determined ex-ante not only to address the investor's climate objective, such as maximising a climate score, but also to explicitly address its tracking error risk budget.

In order to compare the two approaches (Exhibits 3 and 4), we use SciX's own risk model **based on the Instrumented Principal Component Analysis** (IPCA) as an example of the 'risk-model' method[4]. In SciX's case, this leverages both principal component analysis (PCA) and explicit style factor models. Using both is important: the PCA method enables the capture of the main risk drivers in a basket of stocks, but the risk drivers or implicit factors lacks economic interpretability; this interpretability issue can be overcome by incorporating traditional style factors and sector factors. This combination allows for the economic interpretability of the difference sources of risks, while keeping the power of PCA to model stock-level risks.

Exhibit 3 shows the contrast in six-month rolling tracking error for this risk-model methodology (labelled 'climate risk-aware' in the chart) versus a classic climate-tilted methodology (labelled 'climate-tilted'). In both cases, these could have been deemed appropriate for an investor with a tracking error target of 0.5%[5]: in the risk-model approach, this has been executed by targeting an ex-ante risk budget of 0.5% ; in the tilting approach, this has been executed via determining the tilt size based on historic data, as described above. Here, we can see that the subsequent realised tracking error of the risk-model strategy ('climate risk-aware') is **much closer to the investor's risk budget** and less volatile through time. This becomes particularly obvious after 2020, when the climate-tilted strategy overshot the risk budget consistently by roughly 0.5% on average.

Exhibit 3: Six-month rolling tracking error of the climate-tilted and climate risk-aware strategies



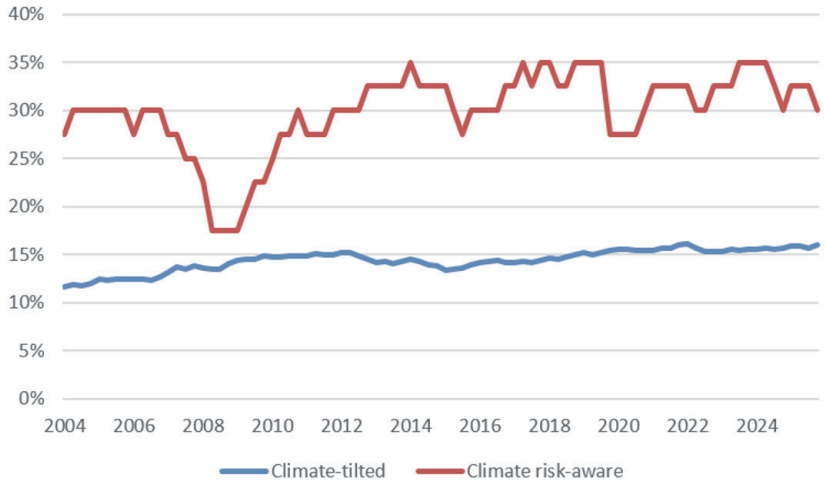
Source: SciX. This illustrates the 6-month rolling tracking error of climate-tilted and climate risk-aware strategies. The rolling tracking error is measured with weekly steps and annualised. The climate-tilted strategy is built with a tilt of 5. The climate risk-aware strategy is built using SciX risk model to estimate stock-level covariance matrix. The optimisation objective is to minimise the ex-ante tracking error under three constraints. The first constraint is a budget constraint, i.e. the sum of weights should be equal to one. The second constraint is based on robust optimisation principle and imposes that the sum of squared active weights should be below the ratio 1/N, where N is the number of stocks in the SciX Developed index. The third constraint is on the physical climate loss. We impose that the physical climate loss reduction should be at least equal to a percentage. To find the optimal solution, we build an efficient frontier, where the physical loss reduction starts at 0% and the increase until no solution is possible. We then pick the optimal solution that is closest to the ex-ante tracking error budget of 0.5%.

4 - The reader can find more details in our factor-based investment philosophy and in a more technical overview linked here.
5 - For proper comparing between the two strategies, we picked ex-post the tilt of the climate-tilted strategy that gives the same average realised tracking error than the strategy using the risk model over the full sample.

Exhibit 4, meanwhile, reveals the physical climate loss reduction relative to the benchmark that would have been achieved by the same two strategies. The results are striking: the 'climate-aware' (risk-model) portfolio has a reduction that is twice as high as the 'climate-tilted' strategy for the same level of average historical tracking error.

Why is this? In short, the tilting approach does not exploit the **heterogeneity of stocks' active risks**, as discussed above. If two stocks, A and B, have the same climate score, the tilting approach will weight them in the same proportion relative to their weight in the benchmark. However, stock A could have a much lower active risk than stock B. The risk-model methodology uses this information to put more active weight on A and lower active weight on B, achieving the same climate score improvement but making more efficient use of the investor's risk budget.

Exhibit 4: Climate physical loss reduction relative to the benchmark of the climate-tilted and climate risk-aware strategies



Source: SciX. This illustrates the quarterly physical loss reduction from June 2004 to June 2026.

If tracking error matters, it should be managed – not assumed

Tilting is popular for good reason: it is simple, transparent and easy to explain. Yet this simplicity comes at a price. Since the tilt says nothing about the ex-ante risk it creates, investors are left choosing a tilt from a back-test and hoping that the past repeats itself. As we have seen, it often does not: the tracking error of tilted strategies drifts well away from its historical average; investors can overshoot their risk budget for years or under-deliver on climate objectives because their risk budget was simply under-used.

A risk-model approach is materially different. It is more complex and, as a result, requires more stakeholder education. However, by estimating the active risk of each stock ex-ante, it keeps the strategy closer to its tracking error budget. Moreover, by exploiting the heterogeneity of stock-level risks, it delivers more climate impact for the same risk.

Investors replacing a core equity benchmark with a climate-aware benchmark should, we argue, consider the relative advantages and disadvantages of these two approaches. This comparison should include the evidence provided by recent market data through the *turbulent twenties*. In short, simple does not always mean beautiful.

About Scientific Climate Indices (SciX)

Scientific Climate Indices, or SciX, is an EDHEC Venture and European provider of climate equity indices for institutional investors, asset managers and investment-product providers. SciX translates climate science, climate-risk data and quantitative risk management into investable equity indices. Its approach combines scientifically grounded methodologies with transparent and financially disciplined customization.

SciX has launched two initial index ranges reflecting areas where investor demand is particularly pressing:

- The SciX Physical Climate Resilience Index Series is designed to integrate physical climate risk into core equity allocations. Existing physical-risk climate analytics often rely on highly granular bottom-up approaches that can be difficult to scale for index design across broad investment universes. SciX addresses this challenge through an original top-down framework designed for index construction, which can be enriched with company-level data as well as customized to client-specific requirements. In its Core version, the series targets an average 15% reduction in long-term physical climate risk for around one percentage point of tracking error relative to the benchmark.
- The SciX Climate Mitigation Index Series addresses the need for more pragmatic and financially disciplined approaches to climate mitigation, in response to investors' desire to focus on real-world decarbonization and their disappointment with respect to the first generation of low-carbon indices. The methodology recognizes the limitations and noise in emissions data and trajectories, the structural differences in carbon footprint between economic sectors and the undesirable consequences of broad exclusions. It also recognizes the importance of testing company-level emissions trends against independent external real-world assessments rather than relying mechanically on self-reported information.

For both ranges, SciX has introduced a new series of core indices based on the robust implementation of defined climate objectives designed to remain very close to traditional benchmarks. These core indices can be used as climate-aware building blocks or replacements for traditional capitalization-weighted benchmarks, or as the starting point for further customization. Where investors require different climate objectives, exclusions or financial constraints, SciX applies a disciplined customization framework. Investors define what they want to achieve; SciX determines how to translate those objectives and constraints into a scientifically grounded, transparent and investable index methodology.

Live analytics, backtesting and simulation allow the financial and climate consequences of design choices to be assessed before implementation, including benchmark deviation, sector exposures, risk concentrations and portfolio constraints.

SciX
An EDHEC Venture

SciX

An EDHEC Venture