MORNINGSTAR Indexes

Climate Benchmarks in Practice: Meeting Evolving Investor Needs

Insights from the Morningstar EU Climate Enhanced Indexes.

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Contents

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Climate change has shifted from a long-range environmental concern to a near-term systemic risk that cannot be diversified away. A recent report from the Network for Greening the Financial System forecasts that a sudden policy shift to cut carbon could cut the gross domestic product by 1%–3% in hard-hit countries,[1] while the International Monetary Fund[2] and Fossil Fuel Subsidy Reform research[3] show this triggers higher company defaults and sharp drops in stock and bond prices across carbon-heavy sectors, putting broad market portfolios at risk.

In 2019, the European Union introduced minimum standards for Paris-Aligned Benchmarks (PAB) and Climate Transition Benchmarks (CTB), creating the first standardized framework designed to measure portfolio alignment with the Paris Agreement's 1.5°C objective. These benchmarks offer a systematic, rules-based approach for mitigating transition risk, communicating climate commitments, and aligning portfolio outcomes with investor expectations.

Over the past five years, practitioner and academic literature has debated how best to meet the regulation's stringent requirements—including initial 50% (PAB) or 30% (CTB) carbon intensity reductions, a mandated 7% annual decarbonization trajectory, exclusions, activity-based screens, and "do no significant harm" principles—while minimizing tracking error and avoiding unintended sector or regional distortions.

Industry progress has been substantial, driven by enhanced environmental, social, and governance data coverage and quality and sophisticated optimization frameworks that balance climate objectives against risk constraints like sector neutrality and turnover limits. Yet, challenges persist, notably the inconsistent integration of scope 3 emissions and the potential erosion of stewardship leverage from rigid activity-based exclusions.

This paper analyses the Morningstar EU Climate Enhanced Index Series, which includes PAB and CTB indexes across performance, volatility, factor exposures, and tracking-error drivers, highlighting key methodological choices and how they shape portfolio outcomes. This is especially relevant now as PAB

1 Network for Greening the Financial System, NGFS Climate Scenarios: Phase V (2024), https://www.ngfs.net/system/files/2025-01/20241108_ngfs_scenarios_phasev_outreach_public_v2.pdf.

2 International Monetary Fund, Energy Transition and Fiscal Policy: Evaluating Carbon Pricing and Fossil Fuel Subsidy Reform (IMF Working Paper WP/24/144, 2024), https://www.imf.org/-/media/files/publications/wp/2024/english/wpiea2024144-print-pdf.pdf.

3 Financial Stability Board, "Climate-Related Risks," accessed March 18, 2026, https://www.fsb.org/work-of-the-fsb/financial-innovation-and-structural-change/climate-related-risks/.

and CTB exclusion criteria, alongside binding portfolio construction rules like weighted average carbon intensity reductions, feature centrally in the SFDR 2.0 product categorization proposals currently under consultation.

Key Takeaways

- Investors Want Climate Alignment Without Losing Beta Exposure: Investors want climate-aligned index solutions that keep tracking error low and preserve core beta, but achieving this is difficult given the stringent CTB/PAB rules and the instability of inputs like supply chain or scope 3 emissions data, which can push turnover and active risk higher.

- Index Optimization Enables Climate Ambition With Low Tracking Error: An optimization-driven approach allows indexes to manage multiple climate constraints simultaneously while maintaining broad market exposure, resulting in historically modest excess returns, low tracking error, and volatility aligned with parent benchmarks across one- to three- and five-year time horizons.

- SFDR 2.0 Makes CTB/PAB a Natural Building Block: SFDR 2.0's shift toward clearer categories and universal exclusions makes PAB and CTB natural foundations for product design, with the impact of exclusions varying by region but offering a consistent regulatory anchor.

Investors Want Climate Alignment Without Losing Beta Exposure

Investor apprehension about ESG's impact on returns has intensified. In Morningstar's 2025 Voice of the Asset Owner Survey, the share citing "return drag" as the top barrier to considering ESG factors in the investment process rose from 38% in 2022 to 53% in 2025. That sentiment sets the backdrop for this analysis.

The EU Technical Expert Group on Sustainable Finance set minimum standards for PAB and CTB. PABs require a 50% lower initial carbon intensity than the parent index plus 7% annual decarbonization. CTBs follow a less stringent trajectory toward well-below-2°C alignment or 30%, both preserving minimum exposure to high-impact sectors to encourage their transition rather than outright exclusion.

PAB and CTB exclusions fall into two groups: baseline screens and activity-based revenue thresholds. Baseline exclusions, which apply equally across both frameworks, reflect universal ESG safeguards required for EU climate benchmarks. The activity-based exclusions introduce the climate-specific differentiation between the exclusion frameworks. The PAB applies stricter revenue thresholds to ensure meaningful reductions in exposure to high-carbon business models.

Exhibit 1 Morningstar EU Climate Enhanced (PAB and CTB) Indexes

Minimum Standards	Climate Transition Benchmark	Paris-Aligned Benchmark
Minimum reduction in weighted average emissions intensity compared with the parent benchmark (scope 1, 2, 3/EVIC)	30%	50%
Minimum average reduction in weighted average carbon intensity (per year) relative to the intensity at inception (scope 1, 2, 3/EVIC)	7%	
EVIC inflation adjustment	(Enterprise Value Including Cash / Previous Enterprise Value Including Cash) – 1	
Active weight in high climate (NACE) impact sector compared with the parent benchmark	0%	
Baseline exclusions	Controversial weapons Controversy and UN Global Compact noncompliance screens Tobacco production (0%)	
Activity exclusions		Oil and gas/supporting products (10% or less) Oil and gas/thermal coal power generation (50% or less) Thermal coal extraction/thermal coal supporting products (0%)
Reconstitution (review frequency) minimum once per year	Semiannual recon/quarterly rebalance	

Source: Morningstar Indexes

Data instability remains a challenge in managing carbon intensity reduction, especially with scope 3 emissions data. Reported scope 3 emissions in particular exhibit a high incidence of extreme year-over-year changes in reported totals, frequently driven by methodological updates such as category additions or financed emissions rather than real economy shocks. Practically, this raises turnover, stresses liquidity in narrower markets, and can push tracking error higher at the margin. Index

optimization mitigates but cannot eliminate the effect; persistent WACI drift driven by disclosure changes tightens decarbonization targets over time. Oversight and transparency are critical.[4]

Index Optimization Enables Climate Ambition With Low Tracking Error

The analysis considered Morningstar's PAB and CTB Enhanced Indexes over three-, five-, and 10-year windows. The results are nuanced. Across markets and horizons, we observe modest excess returns in many cases. Low tracking error and volatility broadly in line with their parent benchmarks evidence that climate alignment need not imply large deviations from core beta.

Performance highlights by horizon and market:

Exhibit 2 Three-, Five-, and 10-Year Performance of Morningstar EU Climate Enhanced (PAB and CTB) Indexes

Excess Return

Region	PAB	CTB
DM	0.28%	0.09%
EM	0.14%	0.42%
Global	0.23%	0.09%

Excess Return

Region	PAB	CTB
DM	-0.27%	-0.08%
EM	0.55%	0.80%
Global	-0.26%	-0.01%

Excess Return

Region	PAB	CTB
DM	0.03%	-0.17%
EM	0.16%	0.71%
Global	-0.14%	-0.27%

Tracking Error

Region	PAB	CTB
DM	1.02%	0.55%
EM	1.58%	1.45%
Global	0.97%	0.54%

Tracking Error

Region	PAB	CTB
DM	0.97%	0.63%
EM	1.45%	1.45%
Global	0.95%	0.62%

Tracking Error

Region	PAB	CTB
DM	0.85%	0.68%
EM	1.63%	1.64%
Global	0.81%	0.62%

Source: Morningstar Direct. Data as of Dec. 31, 2025, in GR EUR

10-Year View (2016-26)

- At the global level, both PAB and CTB Enhanced Indexes show slight outperformance versus their parent benchmarks.
- Developed-markets and emerging-markets variants also deliver positive but modest excess returns.
- Tracking error remains low, with Emerging-Markets PAB Enhanced Index the highest at 1.58%, while developed markets and global are less than 1.5%. In construction terms, that profile is consistent with optimization that minimizes the tracking error subject to binding climate constraints, especially in universes with broad diversification.

4 Aditya Ravi Pillai, Saumya Gattani, and Andrey Litvin, "Reported Carbon Emissions: Challenges in Paris-Aligned Benchmark Construction," The Journal of Impact and ESG Investing, published Oct. 23, 2025, https://doi.org/10.3905/jesg.2025.1.143.

Five-Year View (2021-26)

- Global and Developed-Markets CTB/PAB Enhanced Indexes underperformed modestly, the largest shortfall for Global and Developed-Markets PAB Enhanced Indexes at roughly negative 0.26% to negative 0.27%, while the Emerging-Markets CTB/PAB Enhanced Indexes outperformed, making emerging markets the strongest region in this period.
- Sector dynamics matter. Energy, notably in 2022, alongside industrials and consumer defensive, explained much of the global PAB shortfall.
- Emerging-markets tracking error again is the highest (1.45%), in line with the pattern that smaller or less-diversified universes amplify tracking error when climate criteria are applied.

Three-Year View (2023-26)

- Global CTB/PAB Enhanced Indexes underperformed slightly. Developed markets were mixed, with the CTB negative and PAB marginally positive.
- Emerging-Markets CTB/PAB Enhanced Indexes continued to outperform modestly.
- Emerging-markets tracking error peaked around 1.63%–1.64%, versus less than 1% for global and developed markets, again consistent with universe breadth and the cumulative decarbonization gap that must be closed at each rebalance.

Volatility

- Over 10 years, Global PAB and CTB Enhanced Indexes delivered annualized standard deviations of 12.79% and 12.65%, respectively, near the parent benchmark's 12.56%, despite approximately 50% lower carbon intensity and nontrivial exclusions.
- Over three years, dispersion widens slightly, for example, global CTB annualized standard deviation notching at 9.84% versus its parent benchmark's10.02% but remains modest.
- This is the construction story. The index optimization uses Morningstar's Global Industry Standard Risk Model to preserve core factor exposures while enforcing ESG exclusions and climate constraints.

How Minimal Requirements Are Achieved

The PAB and CTB Enhanced Indexes employ convex optimization with Morningstar's Global Standard Equity Risk model to minimize tracking error while hard-coding climate constraints (initial approximately 50% PAB or 30% CTB reduction and 7% annual glide path) plus sector and country, diversification, and turnover guardrails.

Optimized variants cut turnover and ex-post TE versus tilt constructions in developed markets and developed Europe.[5] The strength of index optimization is disciplined control of active risk: The risk model prices each active weight so that the portfolio can target the required ESG improvement while holding sector and country exposures close to the parent and keeping turnover within guardrails. Its main limitations are complexity and input dependency, since outcomes can be sensitive to model

5 Aditya Ravi Pillai, Saumya Gattani, and Andrey Litvin, "Reported Carbon Emissions: Challenges in Paris-Aligned Benchmark Construction," The Journal of Impact and ESG Investing, published Oct. 23, 2025, https://doi.org/10.3905/jesg.2025.1.143.

specification, covariance estimates, and ESG data quality. Robust governance, periodic model recalibration, and transparent disclosure are essential to sustain its reliability.

Rright-skewed carbon intensity also plays a role. Carbon intensity distributions are heavily right-tailed. Large reductions in portfolio WACI can be achieved by down-weighting a relatively small set of high-intensity outliers, allowing most market weights to remain close to the parent and keeping tracking error contained.[6]

CTB/PAB Through a Factor Lens

Factor lenses help explain the Morningstar CTB versus PAB Enhanced Index differences observed in the data. The use of binding decarbonization, plus sector representation, leads to underweighting large, carbon-intensive leaders. Index weight is commonly reallocated to smaller, lower-intensity names that meet climate thresholds. The Morningstar Global CTB Enhanced Index tends to show stronger momentum, higher volatility, and higher liquidity tilts, consistent with lighter exclusions and a lower initial intensity reduction. The Morningstar Global PAB Enhanced Index is more growth-oriented and more defensive on volatility and shows a higher dividend bias and deeper quality underweights. Both share a similar small-cap tilt relative to the broad market.

Exhibit 3 Factor Exposure Morningstar Global PAB Enhanced Versus Morningstar Global CTB Enhanced

Factor	Global CTB Differential	Global PAB Differential	Tilt Contrast
Style	1.1	-4.8	CTB value-neutral; PAB tilts growth
Yield	0.4	2.5	PAB higher dividend bias
Momentum	6.3	0.9	CTB much higher recent winners
Quality	-4.4	-6.5	PAB deeper quality avoidance
Volatility	4.1	-1.6	CTB riskier; PAB more defensive
Liquidity	3.1	0.8	Both higher liquidity
Size	-3.3	-3.3	Identical small-cap tilt

Source: Morningstar Direct. Data as of Feb. 26, 2026.

In aggregate, an examination of the Morningstar EU Climate Enhanced (PAB and CTB) Indexes shows that investors can obtain material decarbonization with low tracking error and benchmark-like risk, but should expect some periodic dispersion tied to scope 3 data instability, universe breadth, and market leadership cycles.

6 Aditya Ravi Pillai, Saumya Gattani, and Andrey Litvin, "Reported Carbon Emissions: Challenges in Paris-Aligned Benchmark Construction," The Journal of Impact and ESG Investing, published Oct. 23, 2025, https://doi.org/10.3905/jesg.2025.1.143.

SFDR 2.0 Makes CTB/PAB Indexes a Natural Building Block

How Evolving Regulation Is Raising the Profile of CTB/PABs

The Sustainable Finance Disclosure Regulation or the EU's framework that requires financial market participants and advisors to disclose sustainability-related information in a standardized way is being overhauled. SFDR 2.0 aims to streamline sustainable finance classifications, curb greenwashing, and sharpen comparability by forging tighter links between portfolio sustainability outcomes and mandatory disclosures. The overhaul was driven by evidence that the original regime was too complex, hard to compare, and vulnerable to greenwashing. SFDR 2.0 simplifies product categories, tightens minimum standards, and aligns disclosures more closely with the wider EU sustainable finance framework (taxonomy, Corporate Sustainability Reporting Directive, Markets in Financial Instruments Directive, benchmark rules). These changes will reshape the roughly €1 trillion in European passive sustainable fund assets (Q4 2025[7]), positioning PABs and CTBs as cornerstone tools for meeting elevated standards.

Exhibit 4 SFDR 2.0 Summary

Category	Must Invest In (Classification)	Must Exclude	Must Report
Transition products (Article 7)	70% in assets clearly contributing to decarbonization or other sustainability transitions	Controversial weapons, tobacco, or breaches of international norms (CTB exclusions)	Intended impact of product Provisions to measure, manage, and report on intended impact Disclose the principal adverse impact
ESG basic products (Article 8)	70% in assets that integrate sustainability factors	Controversial weapons, tobacco, or breaches of international norms (CTB exclusions)	Sustainability-related indicators to measure strategy and progress
Sustainable products (Article 9)	70% in assets that pursue (defined in the fund's binding strategy and tracked with sustainability indicators) clear and measurable sustainability objectives	Controversial weapons, tobacco, or breaches of international norms (CTB exclusions) Companies involved in all activities listed in Article 12(1) the EU Climate Benchmark Companies developing new coal, oil, or gas projects, or do not have a plan to phase out coal or lignite power generation	Intended impact of product Provisions to measure, manage, and report on intended impact Disclose the principal adverse impact

Source: Morningstar Sustainalytics, 2026.

The PAB and CTB framework gains heightened relevance as SFDR 2.0 mandates universal exclusions, which include controversial weapons, tobacco, and breaches of UN Global Compact/OECD principles—across all product categories, while sustainable products face the full fossil fuel exclusions mirroring EU PAB rules. This regulatory convergence effectively funnels managers toward CTB/PAB frameworks to achieve "Article 8+" or "Article 9" status with minimal methodological friction, prompting a potential reshuffle in fund lineups as providers recalibrate for compliance and disclosure readiness.[8]

In light of this reality, we expect investors will have an increased interest in how these exclusions impact a global portfolio and some of the differences between developed and emerging markets in this context.

7 Hortense Bioy, Boya Wang, and Anna Lennkvist, "How SFDR 2.0 Could Reshape ESG Fund Flows," Morningstar Europe, Feb. 13, 2026.

8 Hortense Bioy, Boya Wang, and Anna Lennkvist, "How SFDR 2.0 Could Reshape ESG Fund Flows," Morningstar Europe, Feb. 13, 2026.

Exhibit 5 Portfolio Snapshot Exclusions

	Global	Emerging Markets	Developed Markets	DM Ex-US	DM Europe	US
Total	2,686	1,469	1,217	726	364	491
Tobacco, UNGC/Controversy, Weapons	58	41	17	9	4	8
Fossil Fuel Activity Screens	231	135	96	63	27	33
Final Count	2,397	1,293	1,104	654	333	450

Source: Morningstar Direct. Data as of Dec. 22, 2025.

Using the past five years of Morningstar's Emerging Markets and Developed Markets Target Market Exposure Indexes, which together represent the top 85% of free-float market capitalization, we examined the average number of excluded securities and the portfolio weight associated with each exclusion category across both baseline and fossil fuel activity exclusions. The review considered both securities explicitly removed for violations of baseline criteria and those omitted because of insufficient data.

Key Findings

- Global standards and norms noncompliance, or companies Sustainalytics identifies as involved in breaches of international norms based on their stakeholder impacts and links to violations of globally recognized standards, is the most significant driver of baseline exclusions across both universes, although the magnitude differs substantially.
- For emerging markets, "baseline exclusions" behave more like a material active bet given the weight impact, which can meaningfully affect regional exposures and tracking error.
- Severe controversies are meaningful in both, but in emerging markets, they are more often the same names, which suggests emerging markets' most severe controversies are more concentrated and correlated—the same companies often trigger multiple baseline screens.
- Oil and gas weight is similar across developed markets and emerging markets, but coal and power generation are not. Emerging markets show much higher coal extraction and coal-linked power generation exclusions, indicating transition constraints in emerging markets are more infrastructure-embedded, which may create country/sector distortions.

Exhibit 6 Five-Year Average Exclusions by Category, Count, and Weight in Parent Index

DM Exclusions From TME 2016-26

Baseline Screen	Average Count	Average Benchmark Weight
UNGC Noncompliant	7	0.72%
Controversy Level 5	9	0.59%
Non-compliant and Level 5 (Overlap)	5	0.27%
Controversial Weapons (AP, BC, CW)	0	0.00%
Controversial Weapons (DU)	5	0.31%
Controversial Weapons (WP)	7	0.33%
Controversial Weapons (DU and WP) Overlap	4	0.20%
Tobacco Production	7	0.69%

EM Exclusions From TME 2016-26

Baseline Screen	Average Count	Average Benchmark Weight
UNGC Noncompliant	40	6.71%
Controversy Level 5	30	1.75%
Noncompliant and Level 5 (Overlap)	25	1.63%
Controversial Weapons (AP, BC, CW)	0	0.00%
Controversial Weapons (DU)	0	0.00%
Controversial Weapons (WP)	30	0.40%
Controversial Weapons (DU and WP) Overlap	0	0.00%
Tobacco Production	19	0.86%

DM Exclusions From TME 2016-26

Activity Screen	Average Count	Average Benchmark Weight
Thermal Coal Extraction	20	0.91%
Thermal Coal Supporting Products and Services	20	1.68%
Thermal Coal Extraction and Supporting Overlap	4	0.13%
Oil and Gas Production	78	5.12%
Oil and Gas Supporting Products and Services	35	1.47%
Oil and Gas Production and Supporting Overlap	3	0.05%
Thermal Coal Power Generation + Oil and Gas Power Generation >50%	4	0.11%
Oil and Gas Production Thermal Coal Power Generation + Oil and Gas Power Generation >50% Combined	2	0.03%

DM Exclusions From TME 2016-26

Activity Screen	Average Count	Average Benchmark Weight
Thermal Coal Extraction	64	2.83%
Thermal Coal Supporting Products and Services	36	1.00%
Thermal Coal Extraction and Supporting Overlap	25	0.60%
Oil and Gas Production	78	5.20%
Oil and Gas Supporting Products and Services	40	1.10%
Oil & Gas Production and Supporting Overlap	18	0.33%
Thermal Coal Power Generation + Oil and Gas Power Generation >50%	20	0.60%
Coal Extraction Involvement and Thermal Coal Power Generation + Oil and Gas Power Generation >50% Combined	4	0.08%

Source: Morningstar Indexes Data as of Dec. 22, 2025.

There are a few areas for further exploration and debate where the new SFDR 2.0 product categories differ from the CTB/PAB framework.

The SFDR 2.0 Category for Sustainable Products (Article 9) introduces stricter exclusions on new fossil fuel projects and coal/lignite phase-out plans that notably go beyond CTB/PAB requirements. This signals that regulators may view CTB/PAB as a floor for benchmark design but want higher ambition for labeled sustainable products, even if it fragments the market and complicates stewardship in high-impact sectors.

The option to use a 15% EU Taxonomy alignment acts as a "safe harbor" shortcut to meet SFDR 2.0's 70% sustainability/transition thresholds for the new product categories. Coverage of EU Taxonomy-aligned capital expenditure within the Morningstar Global All Cap Target Market Exposure Index has already improved as mandatory CSRD reporting comes into force, with the weight of companies reporting rising from 6% at the end of 2024 to 10% by mid-2025, and the reporting population increasing from 570 to more than 740 companies. Although future coverage is expected to stabilize, this step change provides a clearer data foundation and supports the Commission's calibration of the 15% threshold as broadly attainable. For index-tracking strategies, including PAB and CTB funds that already exhibit meaningful exposure to Taxonomy-aligned activities, this strengthens the case that the safe harbor is a practical compliance mechanism rather than a theoretical one.

Exhibit 7 EU Taxonomy-Aligned Capex Morningstar All Cap Target Market Exposure Index. Region: Developed and Emerging Europe (Only)

Date	Weight of Companies with EU Tax Capex Coverage in the Global All Cap Index	Count of Companies with EU Taxonomy Capex Coverage	Weight of Total EU Companies in Global All Cap Index	Total EU Companies in the Global All Cap Index
Dec. 23, 2024	6%	570	13%	1,304
June 23, 2025	10%	747	15%	1,294
Dec. 22, 2025	10%	750	15%	1,265

Source: Morningstar Indexes Data as of December 22nd 2025.

Climate benchmarks are becoming essential tools for managing transition risk as investors seek meaningful decarbonization without sacrificing core-beta exposure. Morningstar's PAB and CTB Enhanced Indexes use optimization to meet stringent emissions reduction and exclusion requirements while keeping tracking error and volatility close to the parent benchmarks. The accelerating evolution of European regulation reinforces this relevance. SFDR 2.0 elevates minimum sustainability standards, introduces universal exclusions, and sharpens the link between portfolio outcomes and product classification, effectively positioning PAB and CTB frameworks as foundational reference points rather than optional overlays. Together, these developments position climate-aligned benchmarks as practical building blocks for sustainable portfolios in Europe and beyond.

About Morningstar Indexes

Morningstar Indexes was built to keep up with the evolving needs of investors—and to be a leading-edge advocate for them. Our rich heritage as a transparent, investor-focused leader in data and research uniquely equips us to support individuals, institutions, wealth managers and advisors in navigating investment opportunities across major asset classes, styles and strategies. In February 2026, the acquisition of CRSP brought the CRSP Market Indexes—benchmarks for over $3 trillion in U.S. equities—into the Morningstar Indexes family. Additionally, CRSP's Research Data Products, renowned for their academic rigor, historical depth and accuracy, will further enhance Morningstar's equity research and data capabilities. This integration unites two trusted sources of market insight, reinforcing a shared commitment to transparency, quality, and investor-focused solutions.

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