CFA Institute
Research & Policy Center

# Aligning Investments with the Paris Agreement: Frameworks for a Net-Zero Pathway

# ALIGNING INVESTMENTS WITH THE PARIS AGREEMENT: FRAMEWORKS FOR A NET-ZERO PATHWAY

**Raul Leote de Carvalho**
Deputy Head of the Quant Research Group, BNP Paribas Asset Management, Nanterre, France

**Jane Ambachtsheer**
Honorary Research Associate, Smith School of Enterprise and the Environment, University of Oxford, and Global Head of Sustainability, BNP Paribas Asset Management, Toronto

**Alexander Bernhardt**
Global Head of Sustainability Research, BNP Paribas Asset Management, Boston

**Thibaud Clisson**
Climate Change Lead, Sustainability Centre, BNP Paribas Asset Management, Nanterre, France

**Henry Morgan**
ESG Quant Analyst, Sustainability Centre, BNP Paribas Asset Management, Nanterre, France

**Guillaume Kovarcik**
Quant Analyst, Quant Research Group, BNP Paribas Asset Management, Nanterre, France

**Francois Soupe**
Co-Head of the Quant Research Group, BNP Paribas Asset Management, Nanterre, France

*We explore two strategies for institutional investors to align equity portfolios with net-zero pathways, drawing on the latest research and industry best practices. We compare the forward-looking approach using "Net Zero Achieving, Aligned, Aligning" screens with the Paris Aligned Benchmark rules framework. The merits and weaknesses of each are discussed, along with an assessment of their potential to support the ambitions of different institutional investors when it comes to steering their portfolios to meet net-zero commitments.*

*The views and opinions expressed herein are those of the authors and do not necessarily reflect the views of BNP Paribas Asset Management, its affiliates, or employees.*

# Introduction

As the world faces the urgent challenge of curbing climate change, institutional investors are increasingly seeking ways to align their portfolios with net-zero-financed emission targets. No unique framework to reach this goal exists, however. According to Giese, Nagy, and Cote (2021), institutional investors can take three types of direct actions for this purpose.

First, investors can shift capital away from more carbon-intensive investments toward less carbon-intensive ones, expecting to impact the share price of companies, their cost of capital, and their access to capital. This shift can be achieved by tilting portfolios toward companies with lower carbon intensity, by tilting portfolios toward the decarbonization leaders based on forward-looking assessments of their rate of decarbonization, or through a combination of both. Second, institutional investors can engage with individual companies directly, whether through shareholder voting or other stewardship activities, with the aim of accelerating decarbonization efforts among laggards. Third, investors can contribute to the decarbonization of the economy by directing investments toward companies providing climate solutions (i.e., products and services relevant for the energy transition and climate change mitigation).

Companies with lower carbon intensity can be found by comparing their carbon emissions normalized by the size of the company using sales, enterprise value, or market capitalization (Ducoulombier and Liu 2021). The GHG Protocol Corporate Accounting and Reporting Standard (GHG Protocol Corporate Standard) categorizes a company's greenhouse gas (GHG) absolute emissions into three *scopes*: Scope 1, direct emissions from owned or controlled sources; Scope 2, indirect emissions from purchased energy; and Scope 3, indirect emissions from the value chain, including upstream and downstream emissions. Scopes 1 and 2, increasingly reported or predicted with sufficient accuracy (Heurtebize, Soupé, and de Carvalho 2022; Assael, Heurtebize, Carlier, and Soupé 2023), are used in calculating the carbon intensities. Scope 3, originally designed just to help companies assess their own global carbon contribution (Ducoulombier 2021), is increasingly a metric that investors expect to see included in company comparisons, despite often being estimated with varying methodologies (Ducoulombier 2021; Busch, Johnson, and Pioch 2022) and difficult to predict (Nguyen, Diaz-Rainey, Kitto, McNeil, Pittman, and Zhang 2023).

In a study on tilting portfolios in favor of decarbonization leaders, Voisin, Tankov, Hilke, and Pauthier (2020) investigated 11 forward-looking methodologies, which include classifications into aligned or not aligned companies, climate scores, percentage of (mis)alignment, and implied temperature rises. They found that results tend to be sensitive to the methodology used.

Methodologies to aggregate all portfolio contributions toward net zero using implied temperature rise indicators have also been proposed. Such methods aim to measure the proximity of a portfolio's climate performance through carbon

intensity, investments in high-climate-score companies, and temperature benchmarks chosen or built based on one or several temperature trajectories. Voisin et al. (2020), however, revealed significant disparities in results from various methodologies applied to the same portfolio. Additionally, de Franco, Nicolle, and Tran (2023) found that the asset-weighted average of asset temperatures underestimates the temperature alignment of major equity. Such unrealistic assessment has generated heated debates about the usefulness of portfolio temperature alignment metrics for transition risk and impact proxies.

Despite all these possible choices, Atta-Darkua, Glossner, Krueger, and Matos (2022) found that institutional investors have primarily decarbonized portfolios by tilting their investments toward lower-emitting companies and to some extent toward climate solution providers and companies with greener revenues. However, they found limited evidence of engagement, even after the 2015 Paris Agreement.

At present, we can identify two leading investment frameworks for a net-zero pathway, which put different emphasis on the three types of direct actions for net-zero investing described previously. The first, the Paris Aligned Benchmark (PAB) approach, based on a regulatory framework proposed by the European Commission, has been adopted by many institutional investors (Azizuddin 2021), in particular in Europe. This framework sets investment constraints for the design of benchmark indexes with a focus on shifting capital away from more carbon-intensive toward less carbon-intensive investments while significantly reducing the carbon intensity of portfolios. It can be used directly for investment purposes—for example, via passive replication of those benchmark indexes or by using those same indexes as benchmarks of active investment strategies.

The second leading framework, which we call the Net Zero Achieving, Aligned, Aligning (NZ:AAA), is a forward-looking approach based on the recommendations in the Paris Alignment Investment Initiative proposed by the Institutional Investors Group on Climate Change (IIGCC), which can be used to screen assets and construct either benchmark indexes or active portfolios. IIGCC criticized the PAB framework by claiming that focusing on current carbon intensity is less important than real-world impact and recommended selecting companies for portfolios based on (1) the net-zero alignment of their forward-looking carbon reduction targets and commitments, (2) the contribution of their products and services to climate solutions, and (3) the expected success of engaging with the companies not yet aligned with net zero. The IIGCC criticism reflects the ongoing debate about the real-world impact from divestment and exclusions of stocks or sectors from portfolios (e.g., Dordi and Weber 2019; Kölbel, Heeb, Paetzold, and Busch 2020; Berle, He, and Ødegaard 2022; Eccles, Rajgopal, and Xie 2022; Rohleder, Wilkens, and Zink 2022; de Franco et al. 2023; Gehricke, Aschakulporn, Suleman, and Wilkinson 2023) and a growing preference for engagement (e.g., Wagemans, van Koppen, and Mol 2018; Blitz and Swinkels 2020; Hoepner, Oikonomou, Sautner, Starks, and Zhou 2024).

In this chapter, we provide practical guidance for investors and practitioners on constructing equity portfolios that adhere to the NZ:AAA recommendations and the PAB constraints using a portfolio construction approach with the objective of minimizing tracking error relative to market-cap-weighted portfolios. We examine both methodologies and their effects on portfolio diversification at the stock and sector levels, on expected risk and returns, and on expected success in terms of driving down real-world carbon emissions. We also discuss the fit of each framework with recommendations from organizations advocating for financial sector net-zero alignment by 2050 and beyond, which are joined by an expanding number of institutional investors. To our knowledge, it is the first time such analysis has been performed, and we believe our study represents a timely and useful contribution to the existing literature on net-zero investing.

From our analysis, we find that PAB rules are effective at reducing the portfolio carbon intensity and provide a clear trajectory for carbon intensity reduction. They may not produce long-term cumulative emission reductions, however, because of their reliance on the reduction of backward-looking historical carbon intensities and the lack of considering a forward-looking dimension[1]—for example, credible plans of companies to decarbonize. Moreover, by divesting from carbon-intensive companies, the PAB framework neither incentivizes investor engagement and stewardship aimed at accelerating a company's progress toward net-zero targets nor invests in companies that, despite higher carbon intensity, may significantly contribute to climate solutions via their products and services. In addition, the PAB framework does not consider that companies in different sectors have varying starting points and thus different levels of effort to achieve net zero.

Conversely, the NZ:AAA framework puts the focus on investing in companies with credible forward-looking commitments to net zero and in companies that contribute to the energy transition with their products and services, with much less focus on achieving overly ambitious levels of decarbonization today. This framework also facilitates engagement with a view to reducing GHG emissions from companies by not excluding all high emitters. Finally, the NZ:AAA framework promotes a smoother transition to net zero by recognizing the varying efforts needed by companies to align with a 1.5°C target. For these reasons, this framework not only is more likely than the PAB framework to deliver real-world reduction in carbon emissions but also is a better fit with the recommendations from the UN High-Level Expert Group, the Institutional Investors Group on Climate Change, and the UN-convened Net-Zero Asset Owner Alliance.

This chapter is organized as follows. In the "Methods and Data" section, we describe the application of each framework in the context of equity investments. For NZ:AAA, we outline the criteria for selecting companies based

[1]The EU PAB regulation does recommend that the weight of companies that set and publish GHG emission reduction targets should be increased in PAB benchmark indexes provided they publish targets and can demonstrate success in their reduction of emissions. This recommendation, however, is voluntary and represents an additional constraint not considered here.

on the alignment of their carbon-reduction targets, contribution of their activity to climate solutions, or the expected success of engagement. For PAB, we summarize the key portfolio decarbonization constraints, as well its exclusions and sector allocation constraints. We also we provide details of portfolio construction using a minimum-tracking-error portfolio optimization.

In the "Results" section, we discuss the practical consequences of adopting either of these frameworks for net-zero investing. Using the MSCI ACWI, MSCI World, MSCI Europe, and S&P 500 indexes as investment universes, we examine the effects on the number of stocks, on the sectors, and on market capitalization available after exclusions. We also explore the effects of adopting minimum-tracking-error portfolios on their expected tracking error, sector biases, and sustainability characteristics.

In the "Discussion" section, we delve into the strengths and weaknesses of each framework, with a focus on the probability of alignment with net zero by 2050, engagement and stewardship, exposure to a net-zero premium should it exist, portfolio diversification, immediate decarbonization, relevance of the effort of companies to reach net zero, forward-looking pledges of companies to reduce carbon emissions, and the impact of their activity on the success of the energy transition. We also examine the alignment of the frameworks with the recommendations of various institutional investor organizations advocating for net zero by 2050 and beyond.

## Methods and Data

In this section, we outline the methodologies of the two net-zero frameworks for equity investments and the construction of minimum-tracking-error portfolios.

### Net Zero Achieving, Aligned, Aligning Screens

The NZ:AAA screens are based on the forward-looking framework recommended by the Paris Aligned Investment Initiative (PAII) and proposed by IIGCC (2021). The PAII recommends investing in companies based on (1) their current and forward-looking alignment criteria that constitute a net-zero transition plan, (2) engagement and stewardship relating to how the company will achieve net-zero targets, and (3) the contribution from their activity to climate solutions. It considers that net zero is more likely achieved by maintaining investment in companies that can deliver real-world impacts and by driving reductions through stewardship and engagement rather than just excluding all high-emission companies from portfolios.

IIGCC (2021) is not explicit, however, about how to assess companies' revenues from climate solutions or the extent to which portfolios should be tilted in favor of those companies. Nor is it explicit about to what extent portfolios should favor companies with ambitious carbon reduction targets or companies that

are priorities for engagement. Investors are given the leeway to make their own choices. In **Exhibit 1**, we show how we chose to categorize companies into the Achieving, Aligned, or Aligning categories. As recommended by IIGCC (2021), we use criteria based on alignment metrics and forward-looking targets. For simplification, we chose to include the companies screened based on their activity contribution to the climate solutions in these categories rather than creating a separate category for them.

For the application of criteria based on alignment metrics and targets, we first used the Science-Based Targets initiative (SBTi) dataset available in May 2023. No companies were flagged as close to their sector trajectory, and thus, no Achieving companies were found using this criterion. Several companies,

## Exhibit 1. Classification of Companies into Achieving, Aligned, and Aligning Based on Either Alignment Metrics and Targets or Revenues from Climate Solutions

| | | | | Achieving Net Zero | Aligned to a Net-Zero Pathway | Aligning to a Net-Zero Pathway |
|---|---|---|---|---|---|---|
| | *Criteria Based on Alignment Metrics and Targets* | | | | | |
| *Either* companies | committed to net-zero emissions by 2050 and beyond | | | Yes | Yes | |
| | with carbon performance at or close to their net-zero-by-2050 sector trajectory | | | Yes | | |
| | that disclose Scope 1, Scope 2, and material Scope 3 carbon emissions | | | | Yes | Yes |
| | with short- and medium-term carbon reduction targets assessed as aligned with temperature increase | | below 1.5°C | | Yes | |
| | | | below 2.0°C | | | Yes |
| | *Criteria Based on Revenues from Climate Solutions* | | | | | |
| *Or* companies | with turnover alignment | with EU Taxonomy on climate change mitigation | at least 50% | Yes | | |
| | | | at least 20% | | Yes | |
| *Or* companies | with turnover alignment | with climate mitigation Sustainable Development Goals, or SDGs (max. 20% misaligned with other SDGs) | at least 50% | Yes | | |
| | | | at least 20% | | Yes | |

however, were classified as Aligned because they had commitments with short- and medium-term targets at or below 1.5°C. Similarly, we found companies that were classified as Aligning because they had commitments with short- and medium-term targets assessed either at or well below 2.0°C.

The SBTi dataset includes a number of additional companies with commitments to disclose Scope 1, Scope 2, and material Scope 3 emissions. Under the PAII, these companies would have been classified as "Committed to Aligning." Instead, we opted to use other data sources as inputs to reclassify these companies as either Aligned or Aligning or to simply exclude them.

For such companies, we used the SBTi tool with data inputs from the Carbon Disclosure Project (CDP) and classified as Aligned all companies producing a ≤1.5°C output for any assessed time frame and all companies with Management Quality Level 4 and a short-, medium-, or long-term carbon performance ≤1.5°C in the Transition Pathway initiative (TPi) assessment. We also classified as Aligned all such companies that passed Indicators 1–6 in the Climate Action 100+ Net Zero Company Benchmark, or CA100+ Benchmark.[2]

Using a similar procedure, we classified as Aligning all such companies producing a >1.5°C but ≤2°C output for any assessed time frame when using CDP data as inputs for the SBTi tool and all such companies with at least Management Quality Level 3 and a short-, medium- or long-term carbon performance between >1.5°C but ≤2°C in the TPi assessment. In addition, we classified as Aligning all companies that passed Indicators 1–3 in the CA100+ Benchmark.

For the first set of revenue-based criteria, we used the Bloomberg EU Taxonomy dataset available at the end of May 2023 and classified as Achieving (Aligned) companies with ≥50% (≥20%) of their turnover aligned with EU Taxonomy climate change mitigation. Turnover refers to the amounts derived from the sale of products and services after the deduction of sales rebates, value-added tax, and other taxes directly linked to it.

For the second set of revenue-based criteria, we used the Matter SDG dataset available from FactSet at the end of May 2023 and classified as Achieving (Aligned) companies with ≥50% (≥20%) of their turnover aligned with climate-mitigation-linked SDG Targets 7.2, 7.3, 7.b, and 9.4 and with no more than 20% of their turnover misaligned with other SDGs.

We excluded all other companies with nonexistent or insufficiently robust climate commitments.

According to IIGCC (2021), this classification enables investors to set and measure the performance of portfolios against net-zero targets and should also inform their strategy for alignment actions. Companies not yet showing

[2]www.climateaction100.org/net-zero-company-benchmark/methodology/.

adequate progress toward meeting NZ:AAA criteria should be the priority for engagement or reweighting in portfolio construction.

When it comes to divestment or exclusions, IIGCC (2021) suggests that consideration should be given to the companies that fail all criteria and are not expected to transition within a time frame consistent with a global net-zero pathway. Companies that do not continue to improve performance against the criteria over the longer term should also be investigated.

## Paris Aligned Benchmarks

The European Commission's Regulation (EU) 2020/1818 introduces standards for the methodology of low-carbon benchmarks in the EU, outlining the minimum requirements for the design of PABs and EU Climate Transition Benchmarks (CTBs). These requirements are based on the commitments set forth in the Paris Agreement and rely on the 1.5°C scenario, with no or limited overshoot, referred to in the Intergovernmental Panel on Climate Change's (IPCC's) special report on global warming of 1.5°C (IPCC 2018). The regulation is consistent with the European Commission's objective of attaining net-zero GHG emissions by 2050.

Here, we focus only on the more ambitious PABs. **Exhibit 2** summarizes the minimum standards of the PAB regulation The regulation specifies the high-impact sectors.[3] Because of the poor quality of available Scope 3 emission data (Ducoulombier 2021; Busch et al. 2022; Nguyen et al. 2023), we did not use these data, not even for the energy and mining sectors as required by the EU regulation.[4]

Following the EU regulation, the GHG intensity of each company is calculated by dividing the sum of its GHG emissions by its enterprise value including cash (EVIC). The regulation determines that when calculating the decarbonization trajectory, the GHG intensity of each company is divided by an inflation adjustment factor, defined as the ratio of the average EVIC of the benchmark at the end of the calendar year to the average EVIC of the benchmark at the end of previous calendar year. These choices imposed by regulation have two consequences that are not always fully appreciated.

First, this inflation adjustment factor forces the absolute emissions of PABs to fall over time. Without this adjustment, absolute emissions of PABs could increase if the EVIC of constituent companies increased faster than their emissions—for example, from sufficiently large increases in share prices from

[3]The high-impact sectors identified in the regulation are as follows: agriculture, forestry, and fishing; mining and quarrying; manufacturing; electricity, gas, steam, and air conditioning supply; water supply, sewerage, waste management, and remediation activities; construction; wholesale and retail trade; transportation and storage; real estate activities.

[4]The EU PAB regulation requires including Scope 3 emissions for the energy and mining sectors already today; for the transportation, construction, buildings, materials, and industrial sectors not later than two years from inception; and for all other sectors within four years from inception.

## Exhibit 2. Regulatory Constraints on Paris Aligned Benchmarks

| Category | Minimum Standard |
|---|---|
| Reduction of GHG intensity relative to investable universe | Minimum 50% |
| Decarbonization trajectory reducing average GHG intensity | Minimum 7% p.a. |
| Allocation to high-impact sectors | At least equal to their aggregate exposure in the underlying investable universe |
| Exclusion of companies | >1% of revenues from hard coal and lignite: exploration, mining, extraction, distribution, or refining |
| | >10% of revenues from oil fuels: exploration, mining, extraction, distribution, or refining |
| | >50% of revenues from gaseous fuels: exploration, extraction, manufacturing, or distribution |
| | >50% of revenues from electricity generation with GHG intensity >100 g $CO_2$e/kWh |
| | In violation of United Nations Global Compact principles |
| | In violation of OECD Guidelines for Multinational Enterprises on Responsible Business Conduct |
| | Related to controversial weapons |
| | Related to tobacco: cultivation and production |

one year to the next. This adjustment is thus crucial for PABs to reduce their absolute emissions over time.

Second, the GHG intensity of a company may fall even if its carbon emissions increase, provided that its EVIC increases faster than the GHG emissions. Similarly, the carbon intensity of a company that is successfully reducing its carbon emissions may increase if its EVIC decreases fast enough—for example, because of the company's share price falling.

### Minimum-Tracking-Error Portfolios against Market-Cap-Weighted Indexes

Both the IIGCC (2021) recommendations for the NZ:AAA framework and the PAB constraints leave sufficiently leeway for portfolio construction. In that sense, we cannot speak of a unique NZ:AAA or PAB portfolio. Instead, we can speak only of portfolios that fit with the recommendations from IIGCC (2021) or portfolios that meet the PAB constraints.

As proposed by Andersson, Bolton, and Samama (2016), we opted for portfolios with the stock weights that minimize the tracking error against the market-cap-weighted portfolio while investing only in stocks screened by the NZ:AAA framework or, alternatively, stocks that meet all the PAB constraints, including the required stock exclusions. We used the BlackRock Fundamental Risk for Equity (BFRE) models for each region at the end of May 2023 for the optimization and calculation of *ex ante* tracking error and beta. As discussed by Andersson et al. (2016), minimum-tracking-error portfolios offer a feasible solution that is likely to be useful for many investors—in particular, institutional investors with large portfolios that tend to set constraints on the tracking error risk they can accommodate relative to the market-cap-weighted portfolios. This solution is also pragmatic for as long as we lack a good enough estimate of a net-zero risk premium. Having such an estimate would be required if we were to better size a risk budget allocation to that premium.

Should a positive net-zero risk premium exist, the minimum-tracking-error portfolios are not necessarily the most efficient for all investors. Although such portfolios are mean–variance efficient, they do not consider views on expected returns: They simply minimize the active risk budget allocated to all risks against the market-cap portfolio, including to any exposure to a net-zero risk premium. Investors convinced of the existence of a net-zero risk premium associated with the stocks leading the low-carbon transition should invest in portfolios with larger active weights versus market-cap-weighted portfolios. Nevertheless, the minimum-tracking-error portfolios required to invest in only Aligned or Achieving companies, or in only Aligning, Aligned, or Achieving companies or subject to PAB constraints should still outperform the market-cap index in the medium to long term, should a positive net-zero risk premium exist.

## Results

In this section, we compare the two frameworks when applied to equities. First, for each framework, we investigate how many stocks are excluded in each region and sector and how much market capitalization is excluded from the investment universe. Second, we consider minimum-tracking-error portfolios to investigate the impact on expected risk and sustainability characteristics of an investment strategy that aims to replicate the performance of the underlying market-cap-weighted portfolio while implementing the recommendations or constraints of each framework. Finally, we summarize our views on each framework's strengths and weaknesses, and we discuss their fit with the recommendations of some key organizations that focus on financial sector alignment with net zero by 2050 and beyond.

### Breadth of the Investment Universe

In **Exhibit 3**, we show the number and the market cap of the stocks that passed each filter from each framework at the end of May 2023. A is used for companies classified as Achieving, AA for companies classified as either

## Exhibit 3. Number of Stocks and Market Cap from Each Region Screened Using Different Net-Zero Filters

| Investment Universe | Description | Index | Achieving, Aligned, Aligning | | | | Paris Aligned | |
|---|---|---|---|---|---|---|---|---|
| | | | A | AA | AAA | Not AAA | PAB | Not PAB |
| MSCI ACWI | Number of stocks | 2,883 | 149 | 666 | 1,065 | 1,818 | 2,473 | 410 |
| | % of stocks | 100% | 5.2% | 23.1% | 36.9% | 63.1% | 85.8% | 14.2% |
| | % of market cap | 100% | 3.5% | 41.5% | 61.1% | 38.9% | 89.4% | 10.6% |
| MSCI World | Number of stocks | 1,506 | 74 | 499 | 798 | 708 | 1,338 | 168 |
| | % of stocks | 100% | 4.9% | 33.1% | 53.0% | 47.0% | 88.8% | 11.2% |
| | % of market cap | 100% | 3.6% | 44.4% | 64.3% | 35.7% | 89.6% | 10.4% |
| MSCI Europe | Number of stocks | 423 | 25 | 223 | 302 | 121 | 394 | 29 |
| | % of stocks | 100% | 5.9% | 52.7% | 71.4% | 28.6% | 93.1% | 6.9% |
| | % of market cap | 100% | 5.0% | 60.8% | 78.7% | 21.3% | 89.6% | 10.4% |
| S&P 500 | Number of stocks | 503 | 19 | 142 | 252 | 251 | 440 | 63 |
| | % of stocks | 100% | 3.8% | 28.2% | 50.1% | 49.9% | 87.5% | 12.5% |
| | % of market cap | 100% | 3.0% | 44.6% | 63.5% | 36.5% | 90.0% | 10.0% |

*Sources:* MSCI; S&P Dow Jones; authors' calculations.

Aligned or Achieving, and AAA for all companies classified as Aligning, Aligned, or Achieving.

Based on the NZ:AAA framework, there are not yet many companies achieving net zero. Moreover, companies currently qualifying as Achieving do so through their activity contribution to climate solutions rather than through alignment of emissions with net-zero pathways. At the global level, only 5.2% of stocks making up 3.5% of the total market capitalization of the MSCI ACWI meet the required criteria. More European companies are achieving net zero than US companies.

If we consider all AAA companies, then the investable universe grows to 36.9% in terms of the number of companies and 61.1% of the market cap of the

MSCI ACWI universe. In the MSCI World, 53.0% of stocks representing 64.3% of the market cap pass the AAA criteria. In the MSCI Europe, 71.4% of stocks representing 78.7% of the market cap meet the AAA criteria index. For the United States, only 50.1% of the stocks in the S&P 500 pass the AAA criteria. Nevertheless, they represent 63.5% of the market-cap weight of the index.

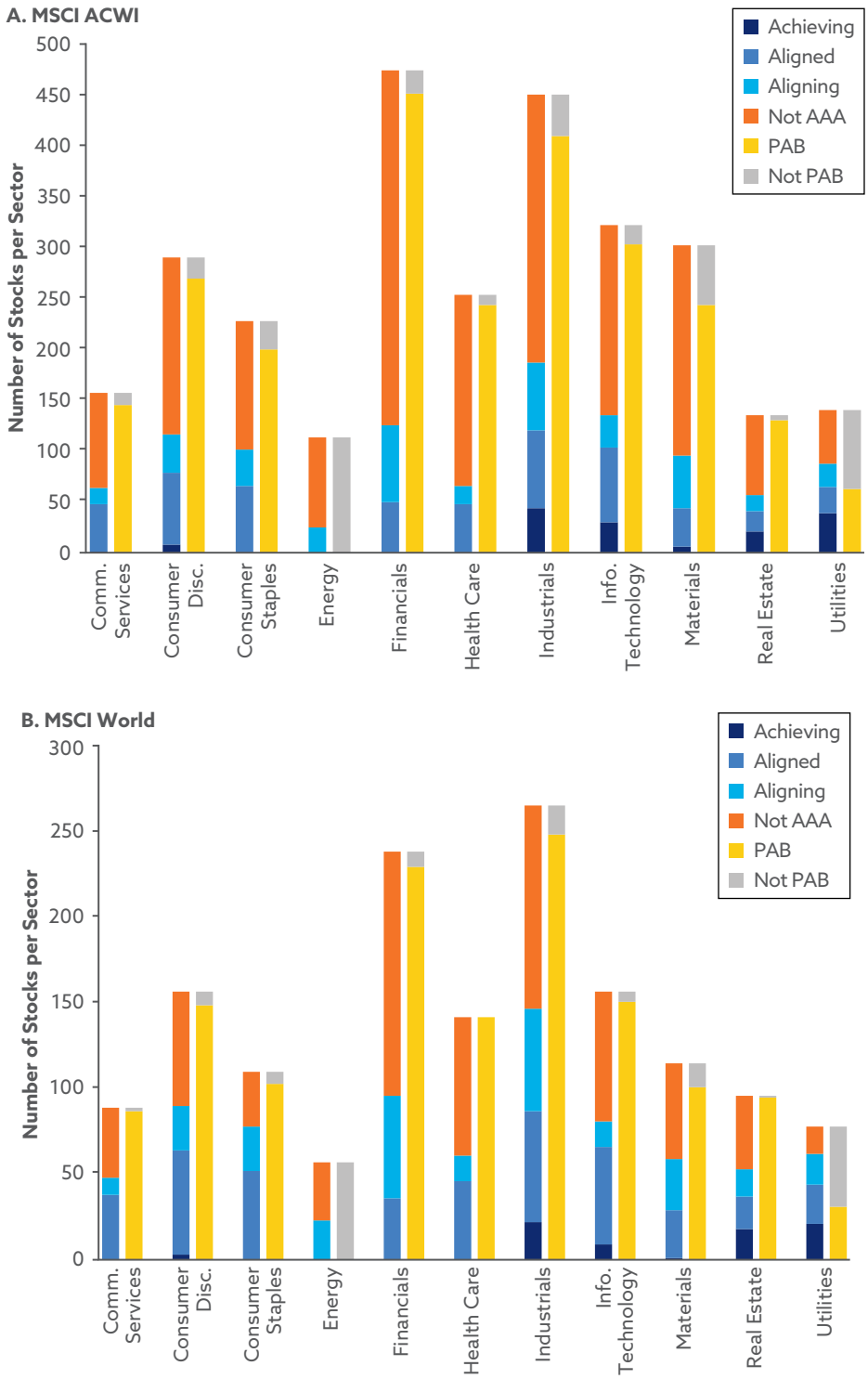
After applying the exclusions imposed by the EU PAB regulation, PABs can still invest in 85.5% of the stocks in the MSCI ACWI, representing 89.4% of market cap. This finding does not mean that any of those stocks can have a large weight in PAB indexes, however, because of the additional constraints (e.g., those on the portfolio carbon intensity reduction). We will consider the impact of other constraints later.

An example of a company classified as Achieving is Iberdrola, with 52% of its turnover aligned with EU Taxonomy. It has committed to net zero and has set targets assessed by SBTi to be in line with a 1.5°C pathway. Alstom is an example of an Aligned company, committed to net zero and with target pledges assessed to be in line with a 1.5°C pathway. Alstom's most significant impact arises from reducing material Scope 3 emissions, from helping to replace diesel trains with electric and hydrogen trains. John Deere is an example of an Aligning company; it has had its targets verified by SBTi and has committed to reduce its Scope 1 and 2 emissions by 50% by 2030 from its 2021 baseline, which is aligned with a 2°C trajectory and thus not ambitious enough to be classified as Aligned. Finally, PGE Polska is an example of a company excluded by the criteria used in the NZ:AAA screens, with turnover alignment with the EU Taxonomy and the climate-mitigation-linked SDGs below 20%, TPi management quality at only Level 1, and not ambitious enough when it comes to decarbonization targets, aligned with a trajectory above 2°C.

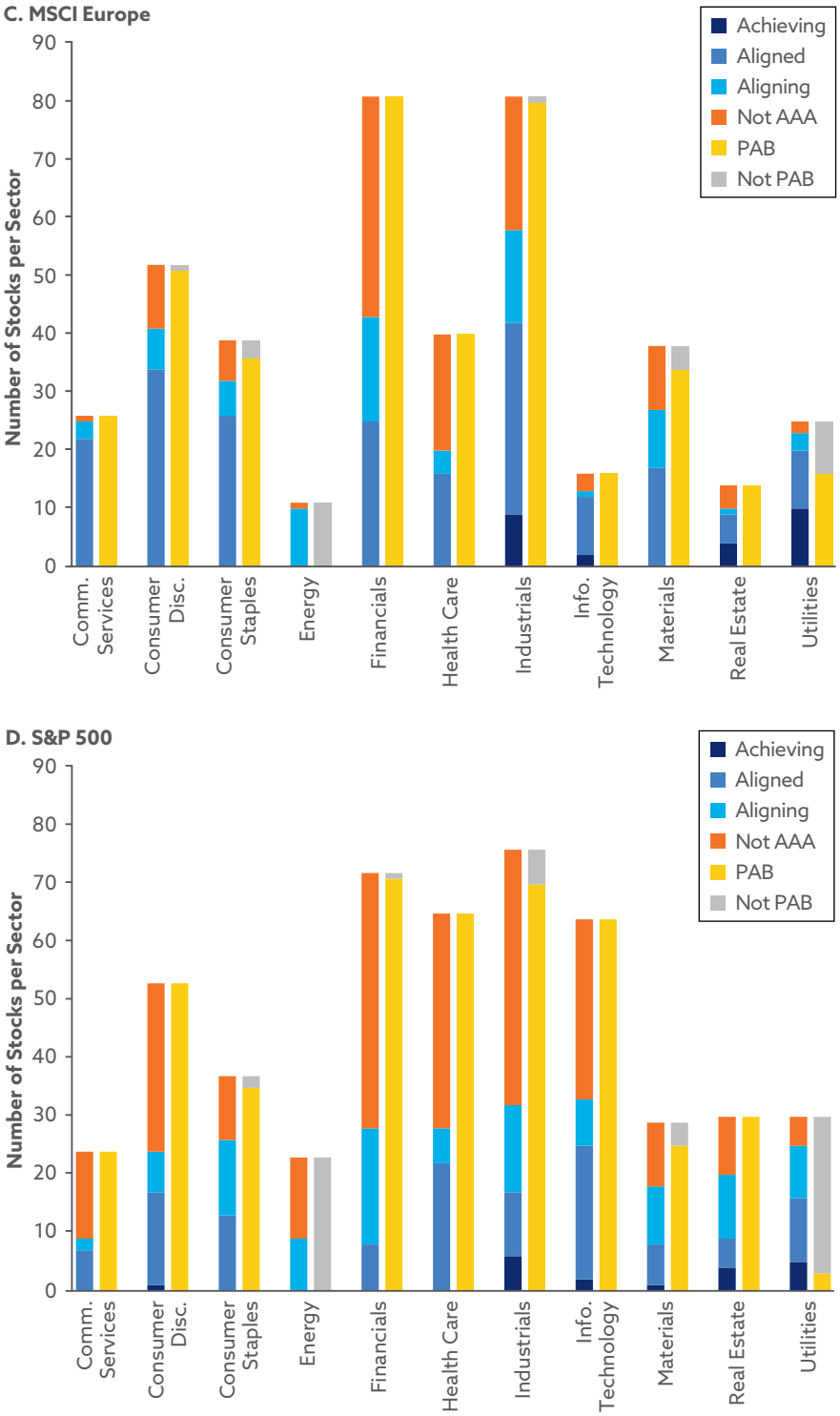
In **Exhibit 4**, we show the number of screened stocks in each sector at the end of May 2023 for the stocks in the MSCI ACWI, MSCI World, MSCI Europe, and S&P 500. No stocks from the consumer staples, energy, financials, or health care sectors were classified as Achieving. All stocks classified as Achieving did so through the alignment of their revenue stream with the EU Taxonomy climate change mitigation or climate-mitigation-linked SDGs. Such stocks are found in the industrials, information technology, real estate, and utilities sectors. The picture changes significantly if we add aligned companies with only the energy sector excluded. If we add stocks that are aligning, then we find stocks from every sector. For the PAB framework, no stock from the energy sector passes the exclusion criteria. Additionally, PAB exclusions tend to screen out at least some stocks from all other sectors.

In **Exhibit 5**, we show the sum of the market-cap weight of the stocks in each sector that passed the various screens at the end of May 2023. The figures represent the sum of the weight in the market-cap-weighted portfolio of all stocks from a given sector that pass each respective screen.

# Exhibit 4. Number of Screened Stocks per Sector Based on NZ:AAA and PAB Frameworks

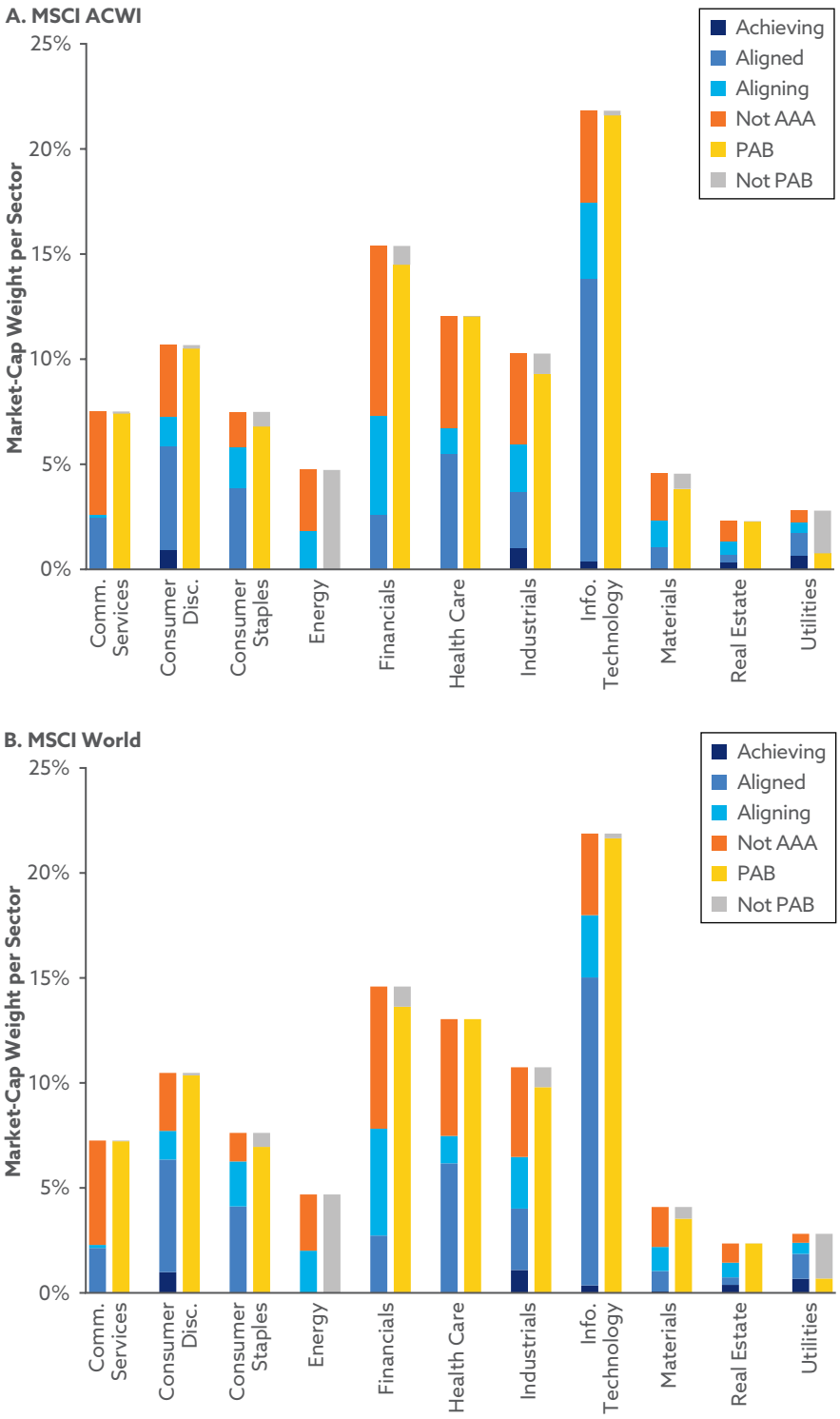


# Exhibit 4. Number of Screened Stocks per Sector Based on NZ:AAA and PAB Frameworks *(continued)*

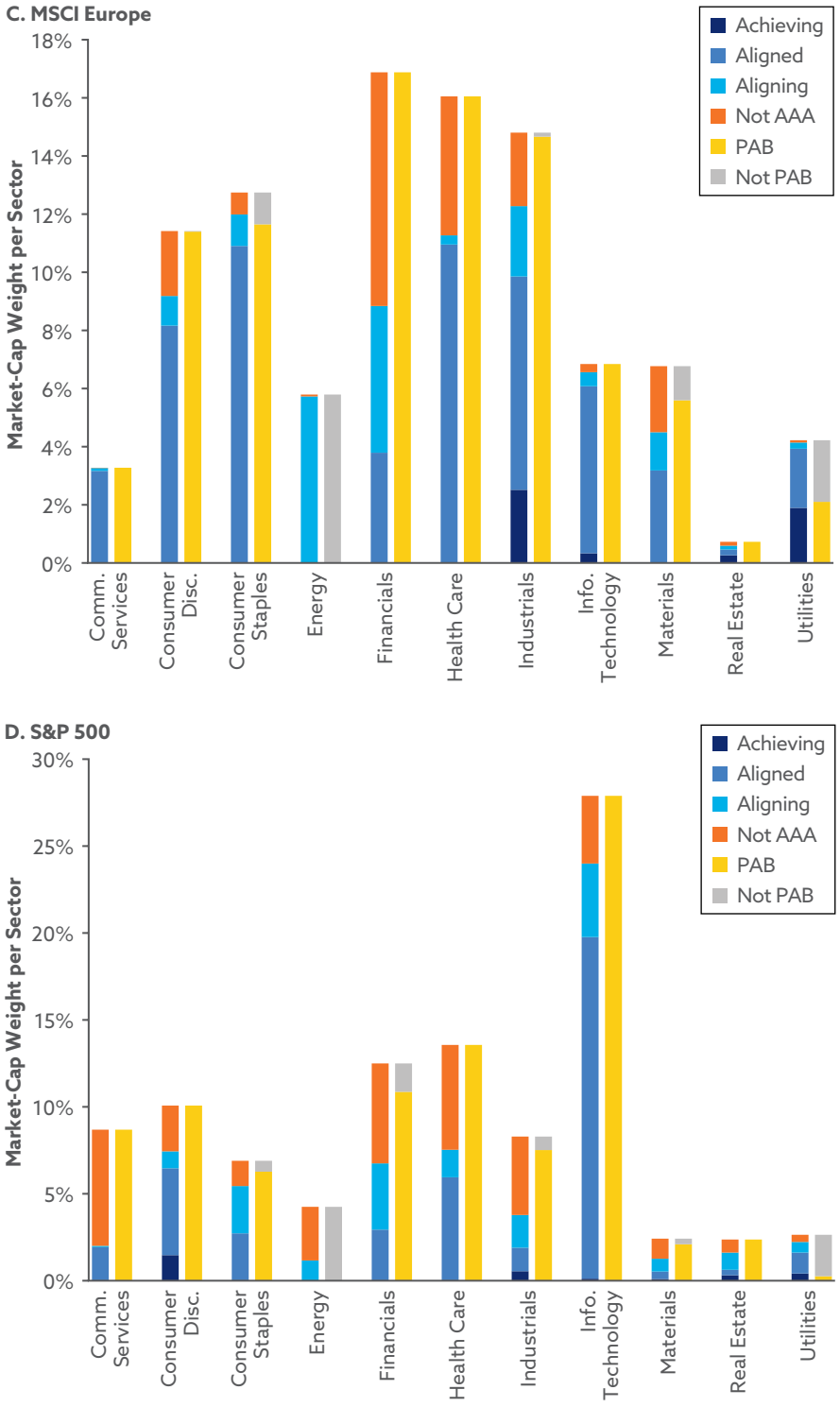



*Sources:* MSCI; S&P Dow Jones; authors' calculations.

# Exhibit 5. Market Cap of Screened Stocks per Sector Based on NZ:AAA and PAB Frameworks



# Exhibit 5. Market Cap of Screened Stocks per Sector Based on NZ:AAA and PAB Frameworks *(continued)*




*Sources:* MSCI; S&P Dow Jones; authors' calculations.

For the largest sector in the MSCI ACWI, information technology (21.9%), the market-cap weight of AAA stocks adds up to 17.5%. Larger sectors, such as consumer discretionary, consumer staples, financials, and industrials, tend to have half or more of their market-cap weight made up of AAA stocks. Materials, real estate, and energy—relatively small sectors—have only about half of their market-cap weight represented by AAA stocks.

Unlike the NZ:AAA framework, for the PAB framework, most of the market cap of all sectors except for energy and utilities is not impacted by stock exclusions. Nevertheless, the total market-cap weight of the utility sector is one of the smallest, varying between 2.7% for stocks in the S&P 500 and 4.2% for stocks in the MSCI Europe. Only the real estate sector has a smaller market-cap weight than utilities.

## Minimum-Tracking-Error Portfolios against Market-Cap-Weighted Indexes

We now look at the impact of the frameworks on the risk, active share, sector allocation, and sustainability of the minimum-tracking-error portfolios for each region at the end of May 2023.

This analysis, based on portfolios on a single date, is not necessarily representative of the future, considering that portfolios will be sensitive to how fast companies align with net-zero pathways and how fast the transition to clean energy will occur, as well as the fact that portfolios will have to be rebalanced periodically. If net zero is reached by 2050, then these minimum-tracking-error portfolios should converge toward the market-cap-weighted portfolio as 2050 approaches. Conversely, if not enough companies align with their net-zero pathway fast enough and, as a result, the number of excluded companies grows over time, then higher tracking errors should grow over time.

### Risk and Active Share

The results in **Exhibit 6** are based on data at the end of May 2023. We can infer that minimum-tracking-error portfolios tend to invest in fewer stocks than those available after exclusions by comparing these results with those in Exhibit 1.

The tracking error of the portfolios invested in AAA stocks is small—only 0.8% for global portfolios and 0.7% for the MSCI Europe. For the S&P 500, it is just slightly higher—1.2%. Moreover, the beta is 1 in all cases. From this perspective, active market risk exposures in the minimum-tracking-error portfolios invested in AAA stocks appear well hedged.

For portfolios invested in AA stocks only, the tracking errors are still small: 1.3% and 1.4% for global and European stocks, respectively. For US stocks, at 2.0%, tracking error is still not too high. Again, beta is 1 for all these portfolios. Thus, investing only in Achieving and Aligned (AA) stocks while minimizing the tracking error against the market-cap-weighted portfolios potentially could

## Exhibit 6. Risk and Active Share of Minimum-Tracking-Error Portfolios

| Investment Universe | Description | Index | Achieving, Aligned, Aligning | | | PAB |
|---|---|---|---|---|---|---|
| | | | A | AA | AAA | |
| MSCI ACWI | Number of stocks | 2,883 | 82 | 444 | 856 | 1,863 |
| | Tracking error | | 4.3% | 1.3% | 0.8% | 0.4% |
| | Volatility | 17.6% | 17.9% | 17.6% | 17.6% | 17.6% |
| | Beta | 1.00 | 0.99 | 1.00 | 1.00 | 1.00 |
| | Active share | | 97.1% | 63.3% | 42.7% | 19.3% |
| MSCI World | Number of stocks | 1,506 | 51 | 391 | 648 | 1,100 |
| | Tracking error | 0.0% | 4.7% | 1.4% | 0.8% | 0.5% |
| | Volatility | 17.9% | 18.3% | 17.9% | 17.9% | 17.9% |
| | Beta | 1.00 | 0.99 | 0.99 | 1.00 | 1.00 |
| | Active share | | 96.9% | 61.1% | 40.0% | 18.8% |
| MSCI Europe | Number of stocks | 423 | 25 | 198 | 298 | 357 |
| | Tracking error | | 6.7% | 1.3% | 0.7% | 0.8% |
| | Volatility | 19.6% | 20.9% | 19.6% | 19.6% | 19.6% |
| | Beta | 1.00 | 1.01 | 1.00 | 1.00 | 1.00 |
| | Active share | | 95.0% | 43.9% | 22.7% | 20.8% |
| S&P 500 | Number of stocks | 503 | 19 | 135 | 243 | 398 |
| | Tracking error | | 6.8% | 2.0% | 1.2% | 0.7% |
| | Volatility | 18.7% | 19.9% | 18.6% | 18.6% | 18.7% |
| | Beta | 1.00 | 1.00 | 0.99 | 1.00 | 1.00 |
| | Active share | | 97.0% | 55.9% | 37.1% | 17.5% |

*Sources:* MSCI; S&P Dow Jones; BFRE models; authors' calculations.

align stock investments with net zero and a temperature increase at or below 1.5°C above preindustrial levels while creating a relatively small impact on risk exposures.

This would no longer be the case, however, if we invested only in Achieving stocks, with tracking errors ranging from 4.3% for the MSCI ACWI to 6.8%

for the S&P 500. We could then expect significant deviations in the performance of these portfolios relative to the performance of the market-cap-weighted portfolios. Thanks to a beta close to 1, however, these larger excess returns are still unlikely to be correlated with the returns of their respective market-cap-weighted portfolios. In terms of absolute volatility, however, these portfolios tend to be somewhat more volatile than all other portfolios considered here.

For minimum-tracking-error portfolios based on the PAB framework, applying all required constraints, including those on decarbonization and minimum allocation to high-impact sectors, we find even smaller tracking errors, varying between 0.4% for the MSCI ACWI and 0.8% for the MSCI Europe, and betas again equal to 1. These findings indicate that the PABs should be able to mimic the returns of the market-cap-weighted indexes over the medium to long term even more effectively than the AAA portfolios, with an even smaller residual performance.

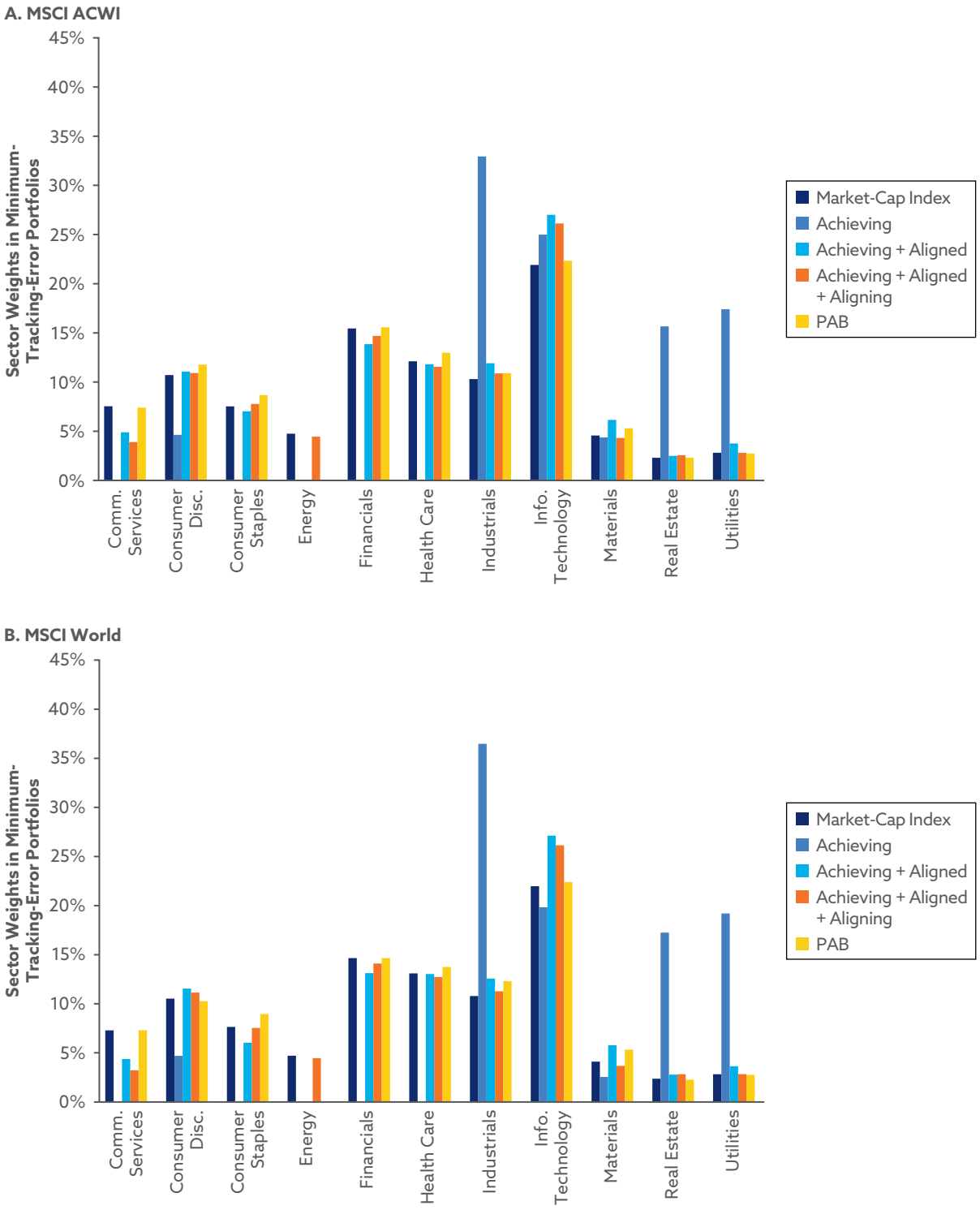
## Sector Biases

In **Exhibit 7**, we show the sector allocation in the minimum-tracking-error portfolios at the end of May 2023. The AAA minimum-tracking-error portfolio is the most sector diversified, investing in all sectors, including the energy sector for which the allocation is close to that in the market-cap-weighted portfolio. The AA and PAB portfolios are well diversified in terms of sector allocation but do not invest in energy stocks. The least diversified are the portfolios invested only in achieving stocks. These portfolios do not invest in communication services, consumer staples, energy, financials, or health care. Such sector biases are likely to generate significant contributions to tracking error and excess returns, even at short-term horizons, resulting from the differences in sector performance.

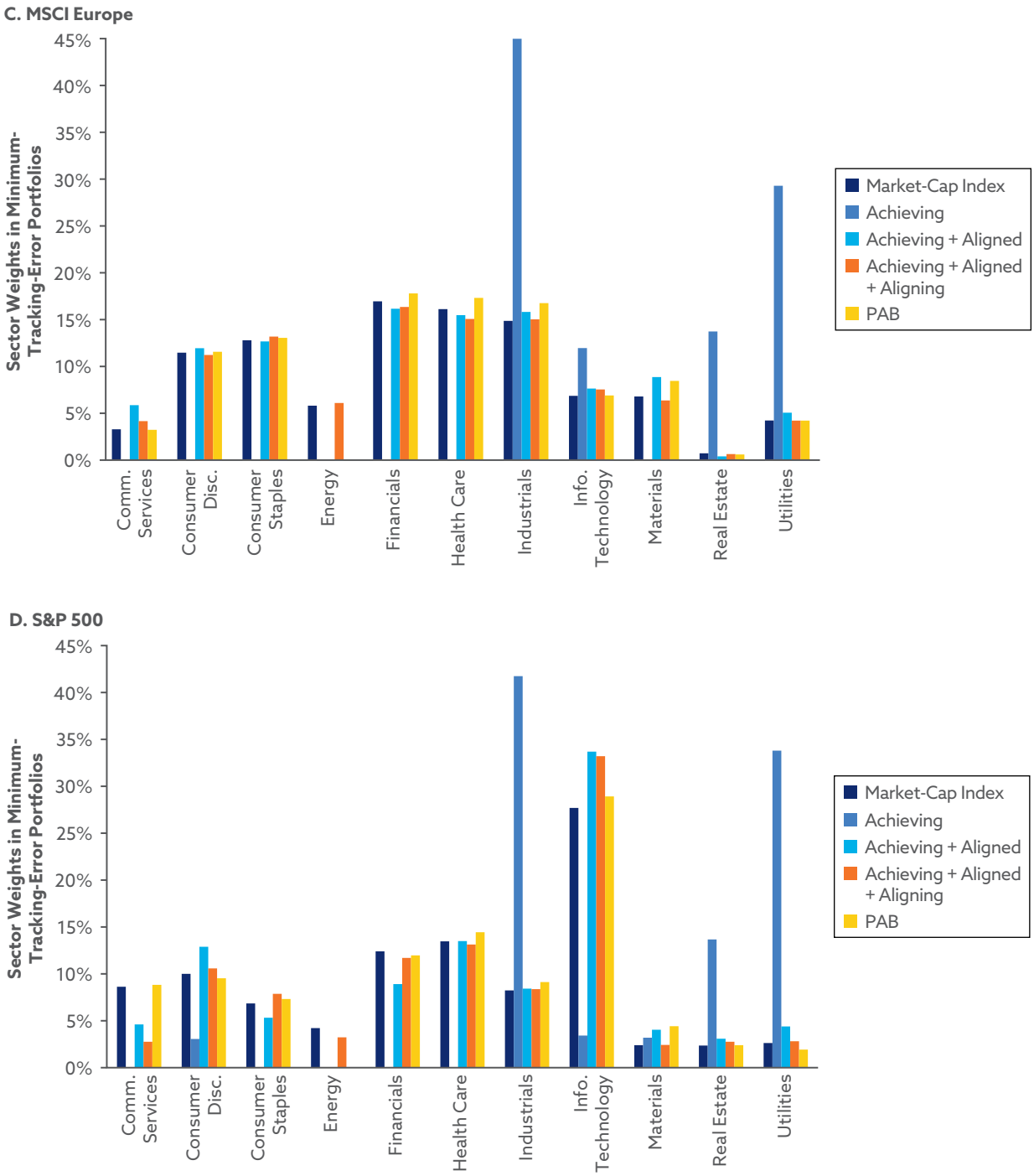
The information technology sector has the largest weight not only in the US and global market-cap-weighted indices but also in their respective minimum-tracking-error portfolios. This holds true even when the number of stocks excluded from this sector is large, as is the case for the A, AA, and AAA portfolios. A large allocation to the sector is required in order to minimize the tracking error relative to the market-cap-weighted portfolios, even if this allocation may be relatively underdiversified in terms of number of stocks from the sector. In turn, despite a similarly large allocation in the S&P 500, the allocation to the information technology sector in the minimum-tracking-error portfolio invested only in A stocks is small, with only two semiconductor and semiconductor equipment stocks from the information technology sector passing the screen.

Because of the large number of stocks and sectors excluded, the portfolios invested in Achieving stocks have the largest sector weight deviations relative to the market-cap-weighted portfolios, significantly overweighting the industrials, real estate, and utilities sectors. The large sector deviations partially explain the larger tracking error for these portfolios.

# Exhibit 7. Sector Allocation of Minimum-Tracking-Error Portfolios Based on the NZ:AAA and PAB Frameworks



# Exhibit 7. Sector Allocation of Minimum-Tracking-Error Portfolios Based on the NZ:AAA and PAB Frameworks *(continued)*




*Sources:* MSCI; S&P Dow Jones; BFRE models; authors' calculations.

### Sustainability Characteristics

In **Exhibit 8**, we show the sustainability characteristics of these same minimum-tracking-error portfolios at the end of May 2023, compared with market-cap-weighted portfolios.

When no ESG constraints were imposed, the AAA minimum-tracking-error portfolios tended to have a higher ESG score than the market-cap-weighted portfolios, except for European portfolios, which already have the highest ESG

## Exhibit 8. Sustainability Characteristics of Minimum-Tracking-Error Portfolios

| Investment Universe | Description | Index | Achieving, Aligned, Aligning | | | PAB |
|---|---|---|---|---|---|---|
| | | | A | AA | AAA | |
| MSCI ACWI | ESG | 54.3 | 54.2 | 59.6 | 57.2 | 57.7 |
| | $CO_2e$ intensity | 72.6 | 81.1 | 54.7 | 62.5 | 36.3 |
| | SI | 37.9% | 83.0% | 46.2% | 44.5% | 39.6% |
| | EU Taxonomy | 2.7% | 26.9% | 5.8% | 4.2% | 2.7% |
| MSCI World | ESG | 54.4 | 54.6 | 59.3 | 57.1 | 57.7 |
| | $CO_2e$ intensity | 60.6 | 65.2 | 45.7 | 50.3 | 30.3 |
| | SI | 38.6% | 87.8% | 44.9% | 43.5% | 40.6% |
| | EU Taxonomy | 2.7% | 27.3% | 5.3% | 3.9% | 2.7% |
| MSCI Europe | ESG | 59.5 | 63.5 | 62.4 | 60.6 | 61.8 |
| | $CO_2e$ intensity | 77.7 | 37.7 | 91.2 | 82.6 | 38.8 |
| | SI | 55.4% | 97.5% | 63.8% | 57.9% | 59.6% |
| | EU Taxonomy | 2.6% | 28.5% | 3.6% | 2.6% | 2.5% |
| S&P 500 | ESG | 53.1 | 52.0 | 58.4 | 56.0 | 57.0 |
| | $CO_2e$ intensity | 54.4 | 101.6 | 34.5 | 36.9 | 27.2 |
| | SI | 34.0% | 74.1% | 38.8% | 39.0% | 37.3% |
| | EU Taxonomy | 3.1% | 26.6% | 5.8% | 4.4% | 3.4% |

*Notes:* The ESG scores used here compare companies in a matrix of 20 sectors in four geographical regions leading to 80 peer groups. ESG scores range from 0 for the worst performers to 99 for the top performers, with 50 being neutral. Carbon intensity is measured in tons of $CO_2e$/EUR1 million EVIC. Under the EU Sustainable Finance Disclosures Regulation (SFDR), sustainable investment (SI) is an investment in an economic activity that contributes to an environmental or social objective, does not significantly harm any environmental or social objective, and follows good governance practices. The EU Taxonomy defines economic activities that can be considered environmentally sustainable.

*Sources:* MSCI; S&P Dow Jones; BFRE models; ESG scores: Sustainalytics financial material factor raw data and ISS and Proxinvest governance data; company emission data: Trucost, CDP, and Bloomberg; EVIC data: FactSet; SI data: BNP Paribas Asset Management; EU Taxonomy data: Bloomberg; authors' calculations.

score of all market-cap-weighted portfolios. We found the same dynamic for the PAB framework as well. The ESG tilts relative to the respective market-cap-weighted portfolios arise mainly from the fact that the screened stocks tend to have higher ESG scores.

If we consider the minimum-tracking-error portfolios invested only in Achieving stocks, it is no longer the case that the ESG score is higher than that for the market-cap-weighted portfolios. Again, European portfolios are the exception.

Also, note that the carbon intensity of the minimum-tracking-error portfolios invested only in Achieving stocks can be higher than that for the market-cap-weighted portfolios, as is the case for global and US stocks. This finding is largely attributable to the significant overweight of the industrials sector in the Achieving portfolio. Many climate solution providers at the global level are classified as industrials and have carbon-intensive operations (Scopes 1 and 2) but produce products or services that serve to reduce downstream emissions (Scope 3). This is not the case in Europe, however, where of the 25 European companies achieving net zero, only 4 have a carbon intensity above that of the MSCI Europe portfolio.

For the AA and AAA minimum-tracking-error portfolios, the European portfolios have a higher carbon intensity than the market-cap-weighted portfolios. This finding makes sense because European high emitters are more prone to publishing carbon reduction targets, a requirement in the NZ:AAA framework. In turn, the minimum-tracking-error portfolios constructed with PAB constraints have the lowest carbon intensity, much lower than that of the respective market-cap-weighted portfolios. This finding can be explained by the explicit decarbonization constraints used to construct those portfolios—in particular, the constraint to reduce the GHG intensity by at least by 50% relative to the market-cap-weighted portfolios.

Finally, when it comes to the portfolio allocation to stocks qualifying as SFDR sustainable investments and to the portfolio allocation to company revenues generated from activities deemed sustainable by the EU Taxonomy, the minimum-tracking-error portfolios invested in Achieving stocks tend to have the highest allocations, with levels typically above those in the market-cap-weighted portfolios. This finding should be no surprise, because such stocks are screened by criteria that include turnover alignment with the EU Taxonomy climate change mitigation and with climate-mitigation-linked SDGs.

## Allocations to Achieving, Aligned, Aligning and Fossil Fuel Stocks

In **Exhibit 9**, we show the sum of the weights of stocks classified as Achieving, Aligned, and Aligning and as fossil fuel stocks in the market-cap-weighted portfolios and in the minimum-tracking-error portfolios at the end of May 2023.

The market-cap-weighted portfolios have the largest allocation to Aligned stocks, with about 40% for all regions except Europe, where it is higher (55.8%).

## Exhibit 9. Allocation of Minimum-Tracking-Error Portfolios

| Investment Universe | Description | Index | Achieving, Aligned, Aligning | | | PAB |
|---|---|---|---|---|---|---|
| | | | A | AA | AAA | |
| MSCI ACWI | Achieving | 3.5% | 100% | 8.7% | 6.2% | 3.3% |
| | Aligned | 38.0% | 0.0% | 91.3% | 57.7% | 38.8% |
| | Aligning | 19.6% | 0.0% | 0.0% | 36.1% | 18.6% |
| | Fossil fuels | 9.4% | 10.2% | 3.5% | 8.2% | 4.1% |
| MSCI World | Achieving | 3.6% | 100% | 7.8% | 5.5% | 3.4% |
| | Aligned | 40.8% | 0.0% | 92.2% | 60.3% | 41.5% |
| | Aligning | 19.9% | 0.0% | 0.0% | 34.2% | 18.7% |
| | Fossil fuels | 9.4% | 12.1% | 3.7% | 8.3% | 3.2% |
| MSCI Europe | Achieving | 5.0% | 100% | 5.1% | 5.4% | 4.9% |
| | Aligned | 55.8% | 0.0% | 94.9% | 70.4% | 59.0% |
| | Aligning | 17.9% | 0.0% | 0.0% | 24.3% | 13.6% |
| | Fossil fuels | 10.0% | 19.5% | 2.4% | 9.7% | 2.5% |
| S&P 500 | Achieving | 3.0% | 100% | 7.5% | 4.4% | 2.8% |
| | Aligned | 41.7% | 0.0% | 92.5% | 62.7% | 42.3% |
| | Aligning | 18.9% | 0.0% | 0.0% | 32.8% | 19.3% |
| | Fossil fuels | 8.6% | 17.8% | 5.6% | 6.5% | 1.9% |

*Sources:* MSCI; S&P Dow Jones; BFRE models; author's calculations.

Aligning stocks make up between 17.9% and 19.9%, and the allocation to Achieving stocks is in the range of 3%–5%. Fossil fuel stocks make up about 10% or less of the weight of market-cap-weighted portfolios.

The minimum-tracking-error portfolios invested in AAA stocks significantly overweight Aligned and Aligning stocks relative to the market-cap-weighted portfolios, slightly overweight Achieving stocks, and underweight fossil fuels relative to the market cap-weighted portfolios. In turn, the minimum-tracking-error portfolio invested only in AA stocks tends to be mainly allocated to Aligned stocks, with allocations above 90%.

The minimum-tracking-error portfolios invested in Achieving stocks tend to overweight fossil fuel stocks relative to the market-cap-weight portfolios, in particular for Europe and the United States. This finding reflects the fact that several such companies meet the criterion of turnover alignment with climate change mitigation solutions.

The PAB minimum-tracking-error portfolios have an allocation to AAA stocks similar to that of market-cap-weighted indexes and a significant underweight to fossil fuel stocks.

## Discussion

In this section, we summarize the strengths and weaknesses of each framework and discuss how each framework meets the recommendations of various institutional investor organizations promoting net-zero investing.

### Strengths and Weaknesses of Each Framework

Our views on the strengths and weaknesses of each framework are summarized in **Exhibit 10**.

The likelihood of being aligned with a 1.5°C trajectory to net zero is higher for portfolios investing in Achieving and Aligned companies provided that those companies deliver on their commitments. The more we invest in companies classified as Aligning (i.e., with a 2°C trajectory to net zero), the less the portfolio is aligned with a 1.5°C trajectory, at least without successful engagement to push Aligning companies to increase their decarbonization efforts. In contrast, companies classified as Achieving because they offer climate solutions are contributing to the energy transition and thus to achieving net zero, even those with high emissions today.

## Exhibit 10. Strengths and Weaknesses of Each Net-Zero Investment Framework

| | Achieving, Aligned, Aligning | | | Paris Aligned |
|---|---|---|---|---|
| | A | AA | AAA | PAB |
| Probability of alignment of portfolio with net zero by 2050 | High | High | Medium | High |
| Exposure to net-zero risk premium | High | Medium | Low | Low |
| Ability to diversify portfolio | Weak | Medium | Strong | Strong |
| Immediate decarbonization of portfolio | Weak | Medium | Medium | High |
| Account for the varying efforts of companies to reach net zero | Yes | Yes | Yes | No |
| Focus on funding the energy transition | Strong | Medium | Medium | Weak |
| Forward-looking approach to net zero | Yes | Yes | Yes | Partial |
| Ability to engage and support stewardship with higher-impact companies | Strong | Strong | Strong | Weak |
| EU Taxonomy exposure | Strong | Medium | Medium | Weak |

By construction, the minimum-tracking-error portfolios minimize the active exposure of the portfolio to systematic risk factors relative to the market-cap-weighted portfolio. The only exposure they can never fully remove is that created by each net-zero framework's constraints and thus the exposure to a net-zero risk premium, should it exist. Thus, higher tracking error and active share should also indicate higher likely exposure to a potential net-zero risk premium. In this respect, should such a premium exist, we expect the portfolios invested only in Achieving stocks to more likely to profit from it.

Conversely, the ability to diversify the portfolio measures the extent to which frameworks exclude fewer stocks and fewer sectors. In this sense, the PAB framework allows for stronger diversification, with the lowest tracking error and beta equal to 1 relative to market-cap-weighted portfolios.

The PAB framework is more effective when it comes to immediate decarbonization of portfolios. Conversely, as shown in Exhibit 8, the NZ:AAA framework may not even reduce the portfolio's carbon intensity today relative to market-cap-weighted portfolios. This failure to reduce the carbon intensity arises from investing in companies generating revenues from climate solutions despite their current elevated carbon intensity and should be seen as a feature of the NZ:AAA framework, however, rather than a weakness.

The PAB rulebook, with strict requirements for the emission trajectory, may not be the most efficient system to reduce real-world emissions over time. To achieve their necessary decarbonization rate, PAB strategies may need to reallocate capital to lower-impact industries, even within high-impact sectors. Such an approach may not encourage companies in high-impact industries to transition to greener operations, decoupling PAB strategies from the real economy and impeding genuine progress toward the 1.5°C target. A more nuanced framework is more likely to avoid these unintended consequences.

The net-zero pathways of companies depend on how far they need to travel from their current business models to achieve alignment with the 1.5°C target. For some companies, the transition will be relatively easy, and for others, it will be more difficult. A best-in-class framework in each sector and region encourages companies from all starting points to make the required incremental changes toward net zero by 2050. Creating portfolios that support an economy-wide transition to a 1.5°C world while also avoiding any unintended negative consequences that could hinder this goal is crucial. The NZ:AAA framework offers a key advantage here: It promotes a smooth transition toward net zero while recognizing that some companies need to make more of an effort than others.

Given how challenging it is to measure Scope 3 emissions, investing solely based on emissions may lead to the exclusion of some climate solution companies just because of their high Scope 1 and 2 carbon intensity. Better aligning with net-zero goals requires strategies that invest explicitly in solution providers based on what they sell rather than just the carbon intensity of their

operations. The NZ:AAA framework offers this benefit, covering a wider range of sectors.

Moreover, net zero may be more efficiently accomplished by investing capital in assets whose emissions are decreasing over time and driving emission reductions through stewardship and engagement with the companies that need to act the most. This approach can be one of the most effective ways to drive real-world impacts within public equity investments. For the PAB framework, there is limited leverage for engagement. In contrast, the NZ:AAA framework allows for targeted and nuanced conversations with companies in specific sectors and regions, which can lead to a focus on their future decarbonization strategy rather than relying solely on their past decarbonization performance.

Finally, although the NZ:AAA framework is based on current and forward-looking alignment criteria that aim to capture the transition potential of companies, the PAB framework instead relies primarily on past carbon data for companies, without considering their anticipated trajectory. And although the annual increase in required decarbonization can be seen as forward looking, as explained by Bolton, Kacperczyk, and Samama (2022), the annual 7% carbon reduction specified in the PAB regulation should be adjusted to take into account different inception dates and to reflect the fact that the remaining carbon budget is finite and depleting rapidly. In that sense, a PAB index created today requires a much faster rate of decarbonization to still achieve net zero by 2050 than one implemented since 2019.

## Alignment with Net-Zero Recommendations

We now discuss the alignment of the net-zero frameworks with the recommendations of various organizations that aim to decarbonize the economy and achieve net-zero emissions by 2050 and beyond.

### UN High-Level Expert Group

On 31 March 2022, the UN established the High-Level Expert Group on the Net-Zero Emissions Commitments of Non-State Entities (HLEG) to develop stronger and clearer standards for net-zero emission pledges by non-state entities—including businesses, investors, cities, and regions—and speed up their implementation. In November 2022, it published five principles seeking short- and medium-term emission reductions targeting net zero by 2050, along with 10 recommendations providing more detail on what is expected from net-zero commitments made by businesses, financial institutions, cities, and regions (HLEG 2022).

Overall, we can expect that the more businesses and financial institutions adopt the HLEG recommendations, the greater the number of companies achieving net zero. Meanwhile, in our view, the NZ:AAA framework fits the HLEG recommendations, in particular about pledges, setting targets, transition away

from fossil fuels, creating a transition plan, and disclosing actionable plans. However, the HLEG recommendations go beyond the criteria currently checked by the NZ:AAA framework. Points such as corporate lobbying alignment with net-zero outcomes are covered by the work of organizations such as Influence Map and included in the dashboard produced by Climate Action 100+. An example is the Global Standard on Responsible Climate Lobbying project, initiated by AP7, BNP Paribas Asset Management, and the Church of England Pensions Board in a process supported by Chronos Sustainability, which issued 14 indicators[5] intended to be applied consistently across all regions and sectors, with companies taking responsibility for the impact of their advocacy. These investors expect corrective action from companies where there is misalignment with the goals of the Paris Agreement.

## Institutional Investors Group on Climate Change

As mentioned before, the PAII was launched by IIGCC in May 2019 to explore how investors can align portfolios with the goals of the Paris Agreement. In March 2021, the PAII published the Net Zero Investment Framework (NZIF) guidelines (see IIGCC 2021), embraced by IIGCC (Europe), Ceres (North America), the Asia Investment Group on Climate Change, and the Investor Group on Climate Change, or IGCC (Australasia). These networks support investors representing more than USD50 trillion to implement the NZIF 1.0. The objectives of the framework are (1) to decarbonize investment portfolios to achieve net-zero emissions by 2050 and (2) to increase investments in the required climate solutions.

The PAII suggests that the PABs are too aggressive in terms of emission intensity reduction and prefers to incentivize the allocation to assets whose emissions are declining over time and to climate solutions. It believes that net zero is more likely achieved by maintaining investment in assets where the real-world impact is maximized through stewardship and engagement with companies that need to transition, rather than excluding them.

The NZ:AAA framework used here is based on the PAII's NZIF 1.0. Small differences from the NZIF 1.0 include the fact that we considered only four categories (versus five for the PAII) and that we combined the climate solutions dimension directly in the Achieving and Aligned screens. Despite those differences, the NZ:AAA framework fits with the NZIF recommendations and can be used as the starting point for the implementation of the NZIF guidelines for portfolio construction, engagement, and stewardship.

[5]Descriptions of the indicators can be found at https://climate-lobbying.com/wp-content/uploads/2022/03/2022_global-standard-responsible-climate-lobbying_APPENDIX.pdf.

## UN-Convened Net-Zero Asset Owner Alliance (NZAOA)

NZAOA is a member-led initiative of institutional investors with USD11 trillion under management. The alliance is committed to transitioning its investment portfolios to net zero by 2050, consistent with a maximum temperature rise of 1.5°C above preindustrial levels.

NZAOA worries that PAB indexes from index vendors may not take into account that (1) policyholders can expect to earn returns commensurate with market-cap-weighted indexes; (2) such PAB indexes may have large tracking error relative to market-cap-weighted indexes,[6] perhaps even growing over time; and (3) members have differing investment horizons, risk and return expectations, and decarbonization targets. NZAOA also discourages the use of PABs because of their too-rapid decarbonization, which is not consistent with the NZAOA principle of allowing for different speeds of decarbonization across sectors and geographies.

The 10 NZAOA key principles for net-zero-aligned benchmarks (NZAOA 2022) seem relatively well aligned with the proposals from the PAII's NZIF 1.0, although NZAOA is vague about engagement and stewardship. Nevertheless, we believe that NZAOA's members can comply with those principles by using the NZ:AAA framework.

## Net Zero Asset Managers (NZAM) Initiative

The NZAM is a global group of asset managers committed to achieving net-zero GHG emissions by 2050 or earlier to limit global warming to 1.5°C above preindustrial levels. Launched in December 2020, this initiative is convened by six investor networks: AIGCC (Asia), Ceres (North America), IGCC (Australasia), IIGCC (Europe), CDP (global), and the Principles for Responsible Investment, or PRI (global). The initiative had 273 signatories with approximately USD61 trillion in assets under management as of 31 May 2022.

At present, the NZAM seems open when it comes to the framework used to achieve global net-zero emissions by 2050 or sooner and puts the focus on disclosing, engaging, partnering with clients, defining interim targets, and making sure that the climate action plan is robust and delivered. In that sense, asset managers are free to use a combination of frameworks for products, provided that the sum will put the products on the path to delivering net-zero emissions by 2050 or sooner on all assets under management.

[6]In this chapter, we use PABs with only the minimum required regulatory constraints applied. Our results show a low tracking error for these PABs relative to market-cap-weighted benchmark portfolios. The commercially available PAB indexes, however, often apply a number of additional constraints that increase their tracking error and concentration.

### Glasgow Financial Alliance for Net Zero (GFANZ)

GFANZ was created in April 2021 by the UN Special Envoy on Climate Action and the COP26 presidency, in partnership with the UNFCCC's Race to Zero campaign. GFANZ is a global coalition of 500 leading financial institutions from more than 50 countries committed to accelerating the decarbonization of the economy. It has two missions: to expand the number of net-zero-committed financial institutions and to establish a forum for addressing sector-wide challenges associated with the net-zero transition. GFANZ represents seven financial sector net-zero alliances (including NZAOA, NZAM, and the Net-Zero Banking Alliance), each with its own governance structure.

GFANZ (2022) has proposed voluntary guidance for financial institutions to use portfolio alignment metrics. The guidance presents a broad pan-sector framework for portfolio alignment measurement and metric selection. Each financial institution is encouraged to use elements of the guidance based on such considerations as its target audience for disclosures and the contractual and regulatory environment within which it operates. In view of this, we believe GFANZ is somewhat agnostic when it comes to defining a net-zero strategy.

## Conclusion

In this chapter, we explored two frameworks for achieving net-zero pathways in investment portfolios: Net Zero Achieving, Aligned, Aligning screens and the Paris Aligned Benchmark rules.

The AAA classification is based on forward-looking data, putting less emphasis on decarbonizing significantly today. Instead, it enables investors to identify, engage with, and steward high-emitting companies. It also maintains exposure to climate solution providers.

The PAB framework focuses on strong decarbonization and establishing a trajectory to reduce portfolios' carbon intensity, relying on historical emission data. It does not support engagement and stewardship with many higher emitters, given that it calls for divestment from them, without clarity on whether doing so will actually reduce emissions.

Our analysis identifies the strengths and limitations of these two frameworks, suggesting that investors' objectives and risk tolerance should be carefully considered when choosing between them. We examined the expected impact of both on the market capitalization and the number of stocks and sectors available for investing in various regions. Both the NZ:AAA and PAB frameworks allow for well-diversified portfolios, with low tracking error relative to market-cap-weighted portfolios. This finding shows that investors can likely align their equity portfolios with net zero without unduly compromising their fiduciary obligations.

We also explored the opportunity for each framework to contribute to net-zero outcomes and discussed how the frameworks align with the recommendations of various organizations that focus on financial sector alignment with net zero by 2050. The NZ:AAA framework seems to align better with the recommendations of the Net-Zero Asset Owner Alliance. In addition, the NZ:AAA framework can identify companies that broadly meet the recommendations, particularly by focusing on Achieving and Aligned companies. Moreover, the NZ:AAA framework is based on the Net Zero Investment Framework recommendations issued by IIGCC. The PAB framework falls short of meeting several recommendations, particularly because of its aggressive decarbonization and divestment from high-impact companies, which makes engagement and stewardship with those companies more challenging.

To conclude, we believe institutional investors have a crucial role to play in driving the transition to a net-zero emissions future. This chapter helps illustrate and clarify the strengths and weaknesses of two important frameworks for investing for net zero by 2050 and beyond.

## References

Andersson, M., P. Bolton, and F. Samama. 2016. "Hedging Climate Risk." *Financial Analysts Journal* 72 (3): 13–32. doi:10.2469/faj.v72.n3.4.

Assael, J., T. Heurtebize, L. Carlier, and F. Soupé. 2023. "Greenhouse Gases Emissions: Estimating Corporate Non-reported Emissions Using Interpretable Machine Learning." *Sustainability* 15 (4). doi:10.3390/su15043391.

Atta-Darkua, V., S. Glossner, P. Krueger, and P. Matos. 2022. "Decarbonizing Institutional Investor Portfolios: Helping to Green the Planet or Just Greening Your Portfolio?" Working paper (20 September). doi:10.2139/ssrn.4212568.

Azizuddin, K. 2021. "Paris-Aligned and Climate Transition Benchmarks: the Success Story of the EU's Action Plan on Sustainable Finance." *Responsible Investor* (28 July).

Berle, E., W. He, and B. A. Ødegaard. 2022. "The Expected Returns of ESG Excluded Stocks. Shocks to Firms' Cost of Capital? The Case of Exclusions from Norway's Oil Fund." UiS Working Papers in Economics and Finance 2022/3, University of Stavanger. doi:10.2139/ssrn.4095395.

Blitz, D., and L. Swinkels. 2020. "Is Exclusion Effective?" *Journal of Portfolio Management* 46 (3): 42–48. doi:10.3905/jpm.2020.46.3.042.

Bolton, P., M. Kacperczyk, and F. Samama. 2022. "Net-Zero Carbon Portfolio Alignment." *Financial Analysts Journal* 78 (2): 19–33. doi:10.1080/0015198X.2022.2033105.

Busch, T., M. Johnson, and T. Pioch. 2022. "Corporate Carbon Performance Data: Quo Vadis?" *Journal of Industrial Ecology* 26 (1): 350–63. doi:10.1111/jiec.13008.

de Franco, C., J. Nicolle, and L.-A. Tran. 2023. "Climate Portfolio Alignment and Temperature Scores." *Journal of Impact and ESG Investing* 4 (2): 66–77. doi:10.3905/jesg.2023.1.083.

Dordi, T., and O. Weber. 2019. "The Impact of Divestment Announcements on the Share Price of Fossil Fuel Stocks." *Sustainability* 11 (11). doi:10.3390/su11113122.

Ducoulombier, F. 2021. "Understanding the Importance of Scope 3 Emissions and the Implications of Data Limitations." *Journal of Impact and ESG Investing* 1 (4): 63–71. doi:10.3905/jesg.2021.1.018.

Ducoulombier, F., and V. Liu. 2021. "Carbon Intensity Bumps on the Way to Net Zero." *Journal of Impact and ESG Investing* 1 (3): 59–73. doi:10.3905/jesg.2021.1.013.

Eccles, R., S. Rajgopal, and J. Xie. 2022. "Does ESG Negative Screening Work?" Working paper (30 April). doi:10.2139/ssrn.4150524.

Gehricke, S., P. Aschakulporn, T. Suleman, and B. Wilkinson. 2023. "The Effect of Divestment from ESG Exchange Traded Funds." Working paper. https://sustainablefinancealliance.org/wp-content/uploads/2023/05/GRASFI2023_paper_834.pdf.

GFANZ. 2022. "Towards a Global Baseline for Net-Zero Transition Planning" (1 November). https://assets.bbhub.io/company/sites/63/2022/10/GFANZ_Towards-a-Global-Baseline-for-Net-Zero-Transition-Planning_November2022.pdf.

Giese, G., Z. Nagy, and C. Cote. 2021. "Net-Zero Alignment: Objectives and Strategic Approaches for Investors." MSCI ESG Research LLC.

Heurtebize, T., F. Soupé, and R. L. de Carvalho. 2022. "Corporate Carbon Footprint: A Machine Learning Predictive Model for Unreported Data." *Journal of Impact and ESG Investing* 3 (2): 36–54. doi:10.3905/jesg.2022.1.059.

HLEG. 2022. "Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities, and Regions." www.un.org/sites/un2.un.org/files/high-level_expert_group_n7b.pdf.

Hoepner, A. G. F., I. Oikonomou, Z. Sautner, L. T. Starks, and X. Y. Zhou. 2024. "ESG Shareholder Engagement and Downside Risk." *Review of Finance* 28 (2): 483–510. doi:10.1093/rof/rfad034.

IIGCC. 2021. "Net Zero Investment Framework 1.5°C: Implementation Guide." Paris Aligned Investment Initiative, Version 1.0 (March). www.parisalignedassetowners.org/media/2021/03/PAII-Net-Zero-Investment-Framework_Implementation-Guide.pdf.

IPCC. 2018. *Global Warming of 1.5°C*. Special report. Cambridge, UK: Cambridge University Press. www.ipcc.ch/sr15/.

Kölbel, J. F., F. Heeb, F. Paetzold, and T. Busch. 2020. "Can Sustainable Investing Save the World? Reviewing the Mechanisms of Investor Impact." *Organization & Environment* 33 (4): 554–74. doi:10.1177/1086026620919202.

Nguyen, Q., I. Diaz-Rainey, A. Kitto, B. McNeil, N. Pittman, and R. Zhang. 2023. "Scope 3 Emissions: Data Quality and Machine Learning Prediction Accuracy." *PLOS Climate* 2 (11). doi:10.1371/journal.pclm.0000208.

NZAOA. 2022. "Development and Uptake of Net-Zero Aligned Benchmarks: A Call to Action for Asset Owners and Index Providers" (November). www.unepfi.org/industries/development-and-uptake-of-net-zero-aligned-benchmarks-a-call-to-action-for-asset-owners-and-index-providers/.

Rohleder, M., M. Wilkens, and J. Zink. 2022. "The Effects of Mutual Fund Decarbonization on Stock Prices and Carbon Emissions." *Journal of Banking & Finance* 134 (January). doi:10.1016/j.jbankfin.2021.106352.

Voisin, S., P. Tankov, A. Hilke, and A. Pauthier. 2020. "The Alignment Cookbook: A Technical Review of Methodologies Assessing a Portfolio's Alignment with Low-Carbon Trajectories or Temperature Goal." Institut Louis Bachelier. www.institutlouisbachelier.org/en/report-portfolios-alignment-with-low-carbon-trajectories/.

Wagemans, Frank A. J., C. S. A. (Kris) van Koppen, and Arthur P. J. Mol. 2018. "Engagement on ESG Issues by Dutch Pension Funds: Is It Reaching Its Full Potential?" *Journal of Sustainable Finance & Investment* 8 (4): 301–22. doi:10.1080/20430795.2018.1485379.