Network for Greening the Financial System

Technical document

Decarbonisation strategies for corporate portfolios of central banks

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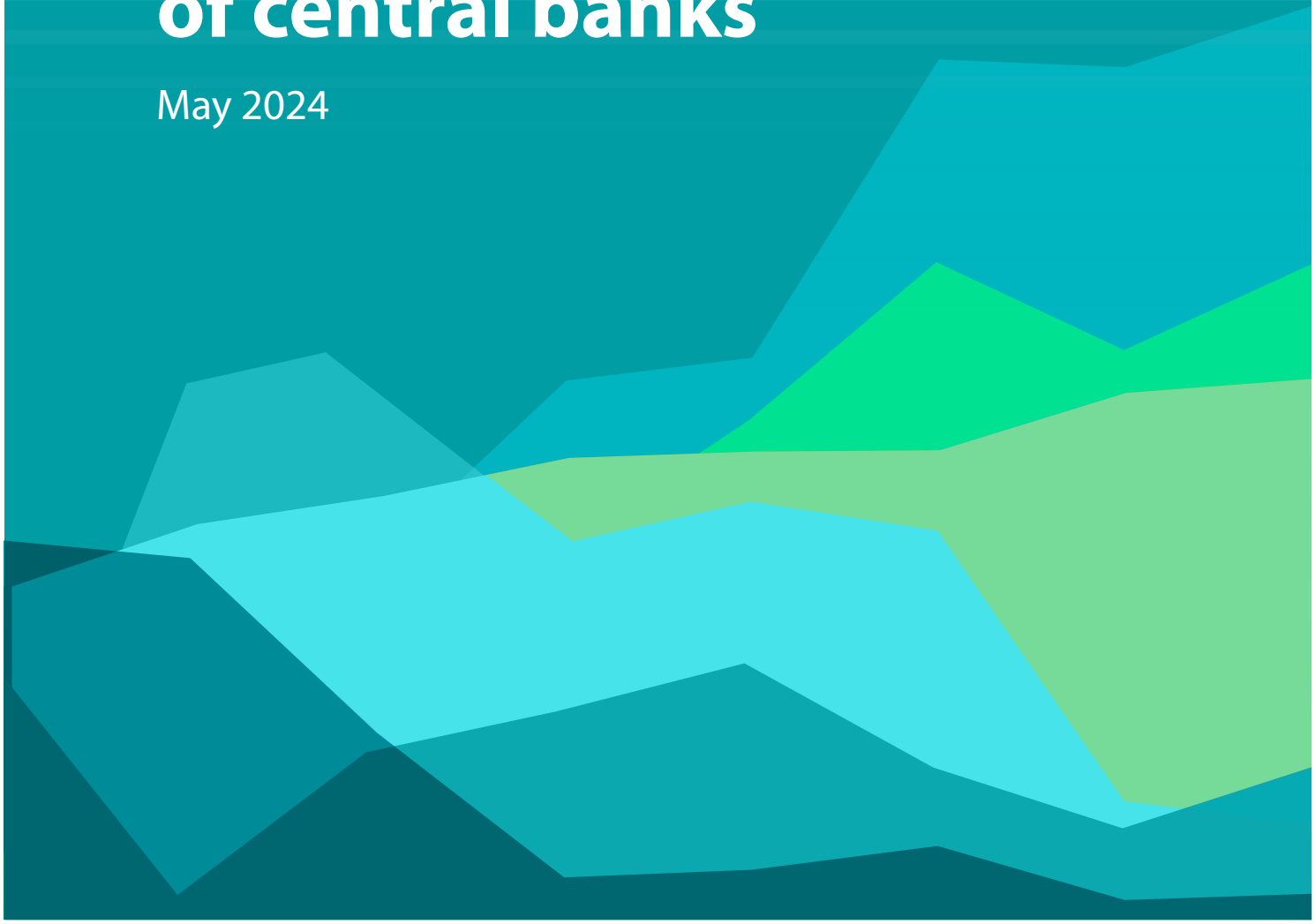

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Table of Contents

Executive Summary 4

1. Why does a net zero approach to corporate securities investment matter for central banks? 5

2. Perimeter, data and metrics for net zero in corporate securities 8

2.1 Perimeters of central banks' assets for net zero investment 8

2.2 Portfolio carbon metrics based on backward-looking data 9

2.2.1 Portfolio carbon metrics 9

2.2.2 A focus on scope 3 GHG emissions 11

2.2.3 Pros and cons of backward-looking data and metrics 11

2.3 Carbon metrics based on forward-looking data 14

2.3.1 Ways to use forward-looking data 15

2.3.2 Pros and cons of forward-looking data 16

3. Modalities of net zero investment: how to design investment strategies? 18

3.1 Portfolio construction 18

3.1.1 Exclusion and divestment 18

3.1.2 Tilting allocation weights in portfolios 20

3.1.3 Climate benchmarks 22

3.2 Stewardship 23

3.3 Thematic investments 27

3.3.1 Green and other labelled bonds 27

3.3.2 Other climate solutions 28

4. Conclusion 30

Bibliography 32

Appendix 35

Acknowledgements 36

Glossary 37

Acronyms 39

Table 1 Overview of portfolio GHG metrics recommended by the TCFD 9

Table 2 Overview of selected climate benchmark decarbonisation drivers, methodologies, examples 23

Table 3 Climate engagement objectives 25

Table 4 Overview approaches to asset engagement 25

Box 1 Deep dive into inflation and exchange rate adjustments for time series on carbon metrics 13

Box 2 Firm-level emissions data 14

Box 3 Corporate transition plans 21

Executive Summary

This technical document discusses decarbonisation strategies for portfolios of corporate securities held by central banks. The document describes the metrics, solutions and practices that central banks may consider for incorporating climate considerations in their investment strategies for corporate stocks and bonds. The purpose for central banks to do so is twofold, namely to manage climate-related risks and, depending on jurisdictions, legislation and individual preferences, also to do their part towards supporting the climate transition. The document illustrates practical examples from the experience of some central banks.

The perimeter for central banks' investment in corporate securities is outlined. Out of all portfolios typically managed by central banks, net zero investment can be most easily incorporated in own fund and pension fund portfolios, as they generally have a diverse asset mix and are less constrained by institutional mandates. Some central banks extend the perimeter to cover part of their foreign exchange (FX) portfolios invested in corporate securities. The climate considerations specific for sovereign holdings are discussed in the twin technical document (NGFS, 2024). Policy portfolios (including FX reserves for currency interventions and portfolios held for monetary policy purposes) are out of the scope of the NGFS SRI documents.

The features, advantages and drawbacks of available metrics to calculate and align central banks' investment to net zero objectives are analyzed. Backward-looking emission data are widely used to monitor and reduce portfolio-level carbon footprints. However, in the light of the growing interest in transition plans (NGFS, 2023a), there is an increasing trend to consider forward-looking metrics, including corporates' decarbonisation ambition and compliance with domestic jurisdictions' decarbonisation policies, carbon transition scores and budgets, among others. The document also discusses the extent to which value-chain related emissions (scope 3) can be incorporated, in addition to scope 1 and 2 emission data.

A review of the prevalent modalities of corporate portfolio decarbonisation is conducted, as well as their relevance for central banks as investors. A well-designed strategy should combine traditional financial objectives and climate-related risks; it can also aim to help to reduce carbon emissions in the real economy. To pursue these objectives three broad portfolio management strategies are discussed. First, underweighting or excluding the highest emitters of greenhouse gas (GHG); alternatively, tilting investment, within certain high emitting sectors, towards the most efficient firms (best-in-class approach). Second, adopting a stewardship approach, which envisions voting and engagement with the management of investee corporates to make the necessary transition efforts and lead GHG reduction in the real economy. Finally, investing in high quality green bonds (bonds whose proceeds are used to finance sustainable projects) or in companies enabling solutions for the climate transition. These approaches are not mutually exclusive; central banks may use them jointly or selectively, based on their specific institutional objectives, mandates and legal frameworks.

Several challenges that central banks face in the implementation of these strategies are reviewed. Compared to traditional investment frameworks, portfolio decarbonisation strategies are still in their infancy and highly depend on the quality and consistency of data (backward- and forward-looking), as well as the alignment methodologies and portfolio models. As regards the net zero approaches, central banks need to consider limitations such as: i) potential trade-offs with the traditional investment objectives (risk-return, liquidity); ii) methodological and conceptual pitfalls, with carbon metrics feeding into "paper decarbonisation" instead of real word carbon reduction (the carbon leakage problem[1]); iii) lack of information on thematic investment making it difficult to quantify impact via harmonized metrics, iv) legal risks and reputational concerns related to directly engaging with listed companies (questions about central banks' independence could arise).

While gaining importance, nature-related considerations beyond climate change are not discussed at length in this technical document because market guidance on how to embed such considerations in investment portfolios is still in its early stage.

1 Carbon leakage can be defined as the situation where, due to stringent climate policies or reputational reasons, businesses were to transfer carbon-intensive production to other firms outside the corporate group perimeter or to countries with laxer emissions policies, which may lead to an increase of emissions. The additional emissions resulting from such actions is considered carbon leakage.

1. Why does a net zero approach to corporate securities investment matter for central banks?

Most countries have committed to reach net zero GHG emissions by 2050 or 2060 to limit global warming within 2 °C above the pre-industrial levels and avoid disastrous consequences for the people and the planet. This high-level objective implies that corporates will need to adapt their business models in the coming years, since they are responsible for a sizeable share of emissions in each jurisdiction.

Two lines of reasoning motivate investors in corporate securities, including both private investors and central banks, to adopt a net zero investment strategy without delay. On the one hand, net zero investment serves as a tool to hedge against climate risks and seize opportunities presented by climate solutions. On the other hand, channelling capital to net zero investment could help facilitate the transition to a low carbon economy. These two objectives may reinforce one another, and coincide with the widely-used concept of double materiality, which considers both the effects of climate change on economic agents and the effects of these agents' activities on climate change.

In considering the first line of reasoning, central banks could, like other investors, measure their carbon exposure and use all levers to hedge against climate transition risk. First, transition risks owe largely to net zero government policies and their implementation as well as to technological and socio-economic changes related to climate (NGFS, 2020). The urgency to mitigate climate change impacts could for instance lead to a faster-than-expected rollout of explicit or implicit carbon taxes, among other carbon pricing mechanisms. Despite current hurdles for international coordination, carbon pricing and carbon taxes could be introduced more extensively and much faster in the future. By end 2022, the carbon price ranges globally from below USD 1 to USD 137 per ton of CO_2 equivalent; the levels in most countries fall far below what is required to be compliant with Paris climate policy goals. Some jurisdictions are already raising or are planning to raise the levels of carbon taxes to make expensive transition technology financially more appealing. This could be a signpost for other countries to follow[2].

The uncertainties around the scope and the pace of implementation of these government policies – with potential risks of being reversed by future governments – expose investors to heightened climate transition risk. This implies that investors in corporates who choose to adopt a net zero investment strategy may stand to lose from this strategy if – for various reasons – governments fail to act against climate change with sufficient strength and consistency. In this scenario, climate change would occur anyway. And the returns for investors that prioritised the net zero objective could be adversely influenced by the lower profits of the "cleaner" firms whereas the investors that decided not to change investment strategies could benefit from the higher profits from the firms that acted opportunistically. This is a caveat that central bank portfolio managers – indeed, every portfolio manager – should be aware of, even if they embrace Sustainable and Responsible Investment (SRI) strategies for corporate portfolios.

In considering the second line of reasoning, some investors steer investment away from polluting business models to contribute directly to reducing GHG emissions. Despite a temporary rebound in 2022, global investment in fossil fuels is 30% below where it was when the Paris Agreement was signed (IEA, 2022). By end 2022, investment in wind and solar assets surpassed that in new and existing oil and gas facilities for the first time, reaching USD 490 billion. Together with investment in nuclear power, electric vehicles, clean grids and storage, data from the International Energy Agency show that annual clean energy investment exceeded USD 1.4 trillion in 2022. This progress however still falls short from the USD 4 trillion of annual investment required to get the world on track for net zero emissions by 2050 (IEA, 2022). Investors have plenty of room to support the green transition further in the energy sector and beyond. Some central banks are mandated to play their part in funding the energy transition.

2 Some advanced jurisdictions, especially in the European Union, have already introduced carbon taxes (explicit or implicit) and are increasing the tax rates and expanding the tax base. The carbon price through the EU's Emissions Trading System (ETS) hit the milestone of EUR 100 in January 2023 and is estimated to go up to EUR160 by 2030. See https://www.reuters.com/markets/carbon/europes-carbon-price-hits-record-high-100-euros-2023-02-21/.

These central banks can support public policies for environmental protection and the mitigation and adaptation efforts for the transition to a low carbon economy[3]. Several central banks in Europe and in Asia have already adopted net zero aligned investment strategies. The more central banks join the collective effort the bigger the real impact on the transition is likely to be, also through their role of leading by example.

To achieve these dual objectives, time is key. There is a consensus that a late transition will be costlier and more disorderly than an early transition, including for investors. The longer the world economy waits to align to a net zero objective, the more disorderly the alignment process will be and the higher risks of deviation from the net zero 2050 path**.** Whereas a reduction in absolute GHG emissions by about 14% per year from 2023 onward would be sufficient to align portfolios with a net zero objective, the necessary decarbonisation effort will jump to 20% per year should the alignment process only start in 2025 (Bolton et al., 2022). More importantly, the economic and financial costs associated with a late transition could be disproportionally magnified, as shown in NGFS climate scenarios[4]. Too slow or too little initial decarbonisation efforts imply a heavier economic and financial burden and a riskier and more challenging implementation, with greater uncertainties at longer horizons.

In this regard, central banks share some common objectives with private investors. Like other investors, central banks need to design net zero strategies in line with their other financial objectives, such as returns, liquidity and safety (WWF, 2022). In addition, as public sector investors, central banks also need to make portfolio allocation in line with their mandate, policy frameworks, and institutional objectives. For instance, the perimeter of corporate investment portfolios, including listed equity and corporate fixed income, which central banks typically consider for net zero alignment, is relatively narrow and can vary from one institution to another. Furthermore, the net zero investment policy of central banks would need to be publicly accountable and in line with the net zero commitments of the jurisdictions where they operate in. In addition, central banks need to practice what they preach.

The implementation of a net zero strategy is however challenging for central banks, as they have various legal objectives ranging from maintaining price stability, safeguarding financial stability and supervising financial institutions. To meet their policy objectives, central banks traditionally hold multiple portfolios to support the tasks outlined in their legal mandates. Out of all portfolios typically managed by central banks, net zero investment can be more easily incorporated in the own fund and pension fund portfolios (the investment portfolios), as these generally have a diverse asset mix and suffer from fewer constraints. Some central banks extend the perimeter to cover part of their foreign reserve portfolios, which could contain corporate assets.

This technical document reviews three complementary management strategies for portfolios of corporate assets:

(i) **portfolio construction,** reducing the exposure to the most GHG intensive emitters without credible transition plans, either within or across sectors,

(ii) **stewardship efforts** via voting and engagement with the corporate management and

(iii) strategies to **fund specific green projects and climate solutions.**

The technical document should be read in tandem with the NGFS WSNZ SRI cover Report (2024), which provides a stock take of the adoption of SRI practices across the NGFS membership, and discusses challenges as well as good practices specific to central banks. Many central banks have, either directly or through external fund managers, initiated a combined use of strategies for different decarbonisation goals, including those under the label of ESG integration, for different portfolios.

Different options of net zero investment strategies also bring different levers on corporates. For instance, reducing financed GHG emissions could be achieved through underweighting or divesting high-emitting companies, such as those operating in coal and unconventional fossil fuel

3 One example is the mandate of the European Central Bank that stipulates that it should "support the general economic policies in the Union with a view to contributing to the achievement of the objectives of the Union as laid down in Article 3 of the Treaty on European Union. Article 3(3) provides, inter alia, that the Union shall work for "the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment".

4 https://www.ngfs.net/ngfs-scenarios-portal/.

sectors, notably if they do not issue credible transition plans. The portfolio decarbonisation is immediate in nominal terms, but such strategy does not necessarily reduce GHG emissions in the real economy unless it permanently raises the cost of funding of more polluting firms[5]. This would happen only if exclusions were implemented by a sufficiently large number of investors such that changes in the cost of capital provide polluting corporates incentives to decarbonise (Xia and Zulaica, 2022). Even in this case, an increase in the cost of capital may have counterproductive effects (Angelini, 2024), therefore the link between divestment decisions and corporates' decarbonisation is complex, with various channels at play, and more empirical research is needed. Direct engagement with corporate management to spur the decarbonisation of their business model could be very effective, but also has notable limitations. It will be more impactful if stewardship practices are adopted by several stockholders large enough to effectively steer the management of corporates to take serious net zero actions. The influence of investors on corporates' sustainability policies does not play in insulation, rather it works within an ecosystem where government policies, customer preferences and technological innovation can significantly concur to the sustainability results. Finally, green bonds or dedicated Environmental, social and governance (ESG) funds could also finance the development of new technologies that drive down future GHG emissions and therefore contribute to the long-term goal of net zero. Credible and verified information on green bonds remains critical to foster the market appetite for this type of labelled instrument.

Making central banks' sustainability goals and the resulting SRI more transparent would help enhance public awareness and accountability. Several central banks have published a clear action plan and are committed to disclose climate-related information on governance, strategy, metrics, and targets, in line with the recommendations of the Task Force on Climate-Related Financial Disclosures (TCFD) and the NGFS disclosure recommendations for central banks (NGFS, 2024). Central banks' commitments may help inspire the private sector to further strengthen its ambition and communication for net zero. The disclosure of targets and metrics can help encourage corporates in the private sector as well as asset managers to develop their own initiatives to reduce GHG emissions in the future (NGFS, 2021). Such action is key, given that the climate goals of central banks will depend eventually on the tangible real progresses towards net zero.

This technical document takes stock of net zero investment strategies available in the market and the experience of selected central banks. This exercise aims to extract useful insights for the central banking community to design and refine net zero aligned investment strategies. Section 2 defines the perimeter of assets considered for alignment of corporate securities portfolios and discusses data availability and metrics used to measure decarbonisation achievements. Section 3 presents modalities of net zero investment strategies and their relevance for central banks. Section 4 discusses several other sustainability objectives and traditional financial objectives that need to be considered when designing net zero investment strategies. Section 5 concludes.

5 A couple of very recent papers, such as Cheng et al. (2023), have shown a significant price impact of the exclusion strategy.

2. Perimeter, data and metrics for net zero in corporate securities

2.1 Perimeters of central banks' assets for net zero investment

Out of all assets on central banks' balance sheets, net zero strategies for investment in corporate assets can most easily be incorporated in own fund and pension fund portfolios as well as in foreign exchange reserves. Central banks typically hold different portfolios with various goals, depending on their respective mandates[6]. Some portfolios are held strictly for policy reasons[7]. These portfolios often have to meet strict requirements in terms of credit quality and liquidity, and generally consist of debt instruments from (semi-)sovereigns, supranationals or agencies. Other types of central bank portfolios, such as pension fund or own fund portfolios (which may comprise part of foreign exchange reserves) are usually less restrictive. These portfolios are often invested in listed equity and corporate fixed income with the aim to generate returns within a certain risk tolerance level. The technical document considers the implementation of a net zero strategy most feasible in own fund, pension fund portfolios (with an explicit mandate from employees) and, in few cases, foreign exchange policy portfolios (Fender et al., 2020; Fender et al., 2022), owing to their composition and investment objective[8].

This document focuses on net zero alignment of corporate investments, including listed equity and corporate fixed income, following wider market guidance. As a first step, central banks may assess possibilities to align their corporate investments to a net zero trajectory, as metrics and data are relatively well-developed for listed equity and corporate bonds. The guidance is based on a variety of sources and initiatives, including standard setters such as the *Partnership for Carbon Accounting Financials* (PCAF), the *Task Force on Climate-Related Financial Disclosures* (TCFD) and the *Principles for Responsible Investment* (PRI), Net Zero investment alliances such as the *Institutional Investors Group on Climate Change* (IIGCC) and the *Glasgow Financial Alliance for Net Zero* (GFANZ), and company alignment initiatives such as the *Transition Pathway Initiative* (TPI) and the *Science Based Targets Initiative* (SBTi).

Data availability is a crucial consideration for the design of net zero alignment strategy and the selection of portfolio-level GHG emissions metrics. Various metrics, both backward- and forward-looking, are useful for setting decarbonisation pathways and measuring progress in a net zero strategy. Backward-looking metrics, such as historical GHG footprints, are relatively easy to calculate but fail to consider the future effects of companies' transition plans. Forward-looking measures estimate a company's projected GHG emissions under different scenarios but suffer from greater levels of uncertainty and complexity. Data and assumptions used for constructing net zero metrics may be inconsistent across data providers as methodologies for estimating historical and projected GHG emissions are not harmonised.

This section provides a detailed discussion on data sources and their limitations. It also identifies various metrics often used in net zero strategies for equity and corporate bond portfolios and discuss the pros and cons of using a combination of metrics for portfolio net zero alignment[9].

6 The Report "SRI in central banks' portfolio management" identifies five different portfolio types (NGFS 2024). The scope of the Report and this TD is limited to the investment portfolios, including the FX investments, own funds, pension funds and third party portfolios.

7 While this report does not cover policy portfolios for market intervention or the execution of asset purchase programmes, interested readers may consider the 19 September 2022 announcement by the European Central Bank on its criteria to decarbonise the portfolio of corporate bonds related to the monetary policy purchase programme.

8 The NGFS published a progress report in 2020 on sustainable and responsible investment, which details the characteristics of central banks' portfolios based on a survey.

9 We do not discuss metrics for climate solutions, such as companies with positive contribution to the energy transition (i.e., green companies), because at a global level no clear consensus has emerged on how to identify green companies. In Europe the EU taxonomy is mostly used to identify green activities.

2.2 Portfolio carbon metrics based on backward-looking data

Backward-looking GHG metrics are the most established way of measuring the climate impact both at security and at the portfolio levels and constitute a key pillar in tracking progress towards net zero. A growing number of market participants, including central banks, report on the GHG emissions of their corporate investment portfolios, using a combination of complementary metrics. While these metrics allow comparing GHG emissions between investee companies and portfolios, a good understanding of the underlying data and methodologies is necessary to ensure proper implementation in net zero strategies. This section first describes the portfolio GHG metrics most often used in net zero strategies, and then discusses the dynamics of these metrics and the shortcomings in the underlying data.

2.2.1 Portfolio carbon metrics

Guidelines for the calculation of portfolio GHG metrics are well-established and widely used by market participants, including central banks. The most widely applied frameworks aim to implement the recommendations of the *Task Force on Climate-related Financial Disclosures* (TCFD). One recent incarnation in the spirit of the TCFD recommendations is the standard set by the *Partnership for Carbon Accounting Financials* (PCAF) as background. So far, at least 3,900 organisations across the world have pledged support for the TCFD. This framework recommends reporting on an array of complementary metrics, to get a full view of the portfolio's absolute and relative GHG emissions. These metrics represent a portfolio-level aggregation of company-level data and are listed in **Table 1**. A number of central banks are reporting on the GHG emissions of their investment portfolios using these metrics, including the Eurosystem central banks[10].

Table 1 **Overview of portfolio GHG metrics recommended by the TCFD**

Metric	Asset class	Description	Formula
Total Carbon Emissions (TCE)	Listed and non-listed	The absolute GHG emissions financed by a portfolio in tons of CO_2-equivalents	$\sum_{i}^{n}\left(\frac{current\ value\ of\ investment_i}{EVIC_i} * emissions_i\right)$
Carbon Footprint (CF)	Listed	The total carbon emissions for a portfolio normalised by the market value of the portfolio, in tons CO_2-equivalents per million dollars invested	$\frac{\sum_{i}^{n}\left(\frac{current\ value\ of\ investment_i}{EVIC_i} * emissions_i\right)}{current\ portfolio\ value}$
	Non-listed, including loans		$\frac{\sum_{i}^{n}\left(\frac{current\ value\ of\ investment_i}{equity + debt_i} * emissions_i\right)}{current\ portfolio\ value}$
Weighted Average Carbon Intensity (WACI)	Listed and non-listed	Weighted average volume of carbon emissions per million dollars of revenue expressed in tons of CO_2-equivalents per million dollars of revenue	$\sum_{i}^{n}\left(\frac{current\ value\ of\ investment_i}{current\ portfolio\ value}\right) x \left(\frac{emissions_i}{revenue_i}\right)$
Carbon Intensity (CI)	Listed and non-listed	Volume of carbon emissions per million dollars of revenue expressed in tons of CO_2-equivalents per million dollars of revenue	$\frac{\sum_{i}^{n}\left(\frac{current\ value\ of\ investment_i}{EVIC_i} * emissions_i\right)}{\sum_{i}^{n}\left(\frac{current\ value\ of\ investment_i}{EVIC_i} * revenue_i\right)}$

Note: EVIC: Enterprise value including cash.

10 For a further discussion on the information value of the different carbon metrics, please see annex 2 of the climate related financial disclosures of the ECB's non-monetary policy portfolios.

To get a good understanding of a portfolio's transition risk exposure it is recommended to consider at least TCE, CF and WACI. *TCE* measures the total emissions that can be attributed to a portfolio and as such give a good impression of the total climate impact. *CF*, *WACI* and *CI*[11]are relative metrics and can be used for comparison across different portfolios. PCAF recommends reporting on TCE, CF and WACI, and TCFD also recommends adding CI. The CF is an ownership metric and captures the emission impact of a portfolio per million invested. The metric allows for comparisons across asset classes as well as differently sized portfolios, and can be used to capture the contribution of individual issuers to portfolio GHG emissions. The WACI and CI are efficiency metrics that can be computed in economic terms (using revenues), or in physical terms (using sector-specific physical units of production). Guidance on the utilisation of physical terms is less established, and therefore not elaborated on in this document[12].

Relative GHG metrics such as the CF and the WACI are commonly used for setting decarbonisation targets. *TCE* are heavily dependent on the portfolio size and thus appear less suitable for comparing portfolios and target setting. As such, market guidance suggests using a relative metric for target setting. Indeed, several international bodies such as the Technical Expert Group on sustainable finance of the European Commission (EU TEG), the Glasgow Financial Alliance for Net Zero (GFANZ) and some of its sector-specific alliances (like the Net Zero Asset Owner Alliance, NZAOA, among other sector-specific alliances), and the Paris Aligned Investor Initiative (PAII) recommend using the *CF* for setting decarbonisation targets at the portfolio level. The *WACI* is often used to assess which firms operate in a more/less GHG efficient manner, for instance to be able to identify engagement opportunities. Research, however, finds that the *TCE*, *CF* and *WACI* are highly correlated across individual emitters implying that choosing one or the other makes little difference (Jondeau et al., 2021). Going forward, central banks could consider using these metrics for setting interim- and long-term decarbonisation targets.

Several methodological challenges apply equally to these metrics whether considered in a backward or a forward looking manner.

The quality, consistency and coverage of GHG emissions data remains an issue, especially where data points are estimated by providers through proprietary models. These methodologies are generally not harmonised, and changes in the estimation method can feed into inconsistencies over time and across providers (see box 2 on GHG emissions data consistency). Ideally, the models used to estimate missing data points should be publicly available, traceable, and verified by a third party.

Over time the metrics are influenced by many factors and not solely by a change in GHG emissions. Market movements affect the underlying financial data of companies and therefore relative carbon metrics (see box 1 for a discussion on the effects of inflation and exchange rates). Emissions data may also change over time as providers update historical data points and methodologies or increase company coverage. Central banks are therefore recommended to perform attribution analyses to identify exogenous factors that may imply fluctuations in the metrics.

Apart from a general concern about data quality, double counting arises when summing up emissions of companies within a portfolio. The aggregation of scope 1, 2 and 3 within an investment portfolio results in accounting for the same GHG emissions more than once and may thus feed into overestimation[13]. Double counting may be less of an issue for investors that want to roughly estimate their exposure to climate transition risk as this leads to a more cautious approach, while for investors that want to precisely measure their financed GHG emissions and impact this may lead to inefficient allocation of investments. However, it is also the case that double counting could be less relevant for setting investment net zero trajectories. First, the metrics may still be applied at the company-level to assess relative changes in GHG emissions over time, where emissions of companies in the value chain become less relevant. Second, as shown in recent papers (e.g., Jondeau et al., 2021)

11 These metrics may be supplemented by additional metrics also listed in the TCFD guidance.

12 See 2021 TCFD report: Implementing the Recommendations of the Task Force on Climate-Related Financial Disclosures, for a discussion of pros and cons of utilising physical carbon metrics.

13 For example, it occurs when a Utility company's Scope 1 emissions are also accounted for in another company's Scope 2 emissions, and its scope 3 emissions include scope 1 and 2 emissions of all other companies in the value chain.

the ranking of GHG emissions across corporates in terms of scope 1 and 2 or scope 1, 2 and 3 emissions are highly correlated within sectors, therefore considering only scope 1 and 2 emissions could be informative as well as less prone to the issue of double counting.

2.2.2 A focus on scope 3 GHG emissions

The portfolio GHG metrics can be calculated using all scope 1, 2 and 3 emissions. These scopes are laid out in the GHG Protocol and describe the level of control a company has over its emissions. Scope 1 includes direct emissions from the company's owned assets and operations, while scope 2 captures emissions from purchased energy. Scope 3 refer to those emissions that occur outside the boundaries of the corporate's own activity, as an input (upstream) or output of this activity (downstream, including waste processing)[14].

It is important to consider scope 3 in order to have the real picture of the carbon footprint of an issuer. A narrow focus on scope 1 and 2 GHG emissions can hamper efforts to allocate more capital towards substitutable processes or products within sectors and reduce overall emissions and create incentives for a firm to push scope 3 emissions out of its accounts and out of the radar by reducing vertical integration. Although scope 3 emission reporting is not mandatory, an increasing number of entities also disclose their scope 3 emissions. Encouraging disclosure and setting targets for scope 3 emissions is especially important for high-emissions sectors, and for companies with relatively high levels of indirect emissions such as financials[15]. Central banks may consider a gradual phase-in approach for including scope 3 targets, starting with critical sectors[16].

However, the poor availability and quality of scope 3 data, and the lack of consensus on how to incorporate them in the assessment of portfolio-level carbon footprints will remain important hurdles. Net zero investors may account for scope 3 emissions in their portfolio construction (e.g., to reduce exposure to high emitters within each sector) and in their stewardship activities in order to incentivise companies to decarbonise throughout their value chain. Data providers typically rely on sector average features and do not consider corporate-specific circumstances when estimating scope 3 emissions, making it difficult to compare companies from different sectors. Still, inclusion of scope 3 emissions can provide relevant information when used for comparison at the sector-level or business-segment level. Further improvements of data quality and availability may stem from initiatives of international standard setters, such as the ISSB to set a common baseline to foster applicability of methodologies and comparability across jurisdictions.

Investors may also account for total projected scope 3 emissions over the lifetime of a product especially when the downstream emissions (the use of the product) represent the largest share. It may not always be desirable to aim for lower scope 3 downstream emissions (associated with the goods and services a company sells), as many sustainable products with a long lifecycle tend to have high downstream scope 3 emissions, even though they could lower scope 1 emissions over their life cycle (e.g. energy efficient light bulbs). On the contrary, upstream scope 3 emissions should always be reduced (associated with the goods and services a company uses as inputs into its production). These upstream scope 3 emissions tend to be relatively consistent across providers, give a good overview of climate impact and correlate with scope 1 and 2 emissions. Lifetime accounting is important but can also raise concerns for some specific sectors and industries.

2.2.3 Pros and cons of backward-looking data and metrics

Backward-looking portfolio GHG metrics have clear advantages. For instance, past GHG emissions data are relatively easy to gather and some of the portfolio GHG metrics would only require limited input of companies' financial data. Moreover, the metrics are intuitive and calculation tools can be developed in-house. Furthermore, the metrics are versatile in their application.

14 Companies can often be incentivized to reduce scope 3 emissions as they hold considerable influence in their upstream and downstream supply chain decisions.

15 NZAOA, IIGCC and GFANZ suggest disclosing and setting targets on a number of critical sectors including oil and gas, utilities (including coal), transport, materials, agriculture, forestry & fisheries, chemicals, construction, water utilities and textiles and leather. PCAF requires disclosure for these sectors starting in 2023 but recommends disclosure of all scope 3 emissions.

16 For an emerging literature on the quality of scope 3, see Busch et al. (2020), and Ducoulombier (2021).

Backward-looking metrics can also be used in a forward-looking manner, for instance by committing to an allocation based on observable "past" or "current" emissions which will be measured in the future. Asset managers can pre-announce the trajectory of emissions above which they would exclude firms in the future. The advantage of such strategies is that it is straightforward to link it to GHG emissions reductions. It also uses observable and relatively consistent data on the GHG emissions of corporates, when they become available in the future, rather than commitments of carbon reductions that such corporates may not respect eventually.

At the same time, the information value of backward-looking portfolio metrics is limited, with several notable methodological and data issues. First, the CF and WACI can be improved by simply underweighting high GHG emitters, some of whom may have credible transition plans. While divesting could help in reducing the portfolio's transition risk exposure, notably in terms of high emitters' liabilities becoming stranded assets, whether this also helps reduce real world GHG emissions is not warranted. Indeed, only when a large enough share of investors decides to sell-off high GHG emitters, could we see a transition of their business models away from carbon due to the induced increase in their cost of capital[17]. The real world effect also depends on how elastic demand for what high emitters produce is and whether cost-efficient alternatives exist (for instance, the renewables as a substitute for fossil-fuel energy). Moreover, if a large enough share of investors decided to stop financing high emitters, but no alternative solution existed, the price of high emission products would skyrocket (the fallacy of composition argument, proposed by Angelini, 2024).

Second, backward-looking carbon emissions metrics, especially when they focus on emissions flows, may disproportionally disadvantage the emerging and developing economies that are catching up with their peers in advanced economies. This is because in the historical emission perspective, more energy use is needed to support strong economic development, therefore the biggest emerging market economies may end up being the highest emitters. These countries need to make their economic development compatible with the increasingly tight climate regulations and backward-looking data may not reflect their commitment to net zero looking-forward.

Finally, backward-looking metrics provide limited information on companies' transition risks as well as their ability to align with a net zero trajectory. They do not account for corporate transition plans and therefore can be used to identify net zero alignment at the issuer level only ex post. Tilting or excluding based only on these metrics could produce short-sighted portfolio allocation and impair efforts to reduce emissions by high emitters.

However, regardless of the limitations of the existing metrics, investors need a consistent way of assessing transition risk exposure to be able to distinguish between the winners and the losers of the net zero transition. Currently, the clear guidance on calculation of backward-looking metrics provided by TCFD/PCAF is the most acknowledged option for harmonising assessment across the market. The calculation of forward-looking metrics is still subject to wide ranging and often nontransparent assumptions, and therefore more likely to feed into incomparable assessment of transition risk.

17 However, in view of the trend toward ESG, the fear of holding stranded assets may also imply runs on brown assets. For a discussion of this mechanism see Jondeau et al. (2021)

Box 1

Deep dive into inflation and exchange rate adjustments for time series on carbon metrics

Relative GHG metrics – such as the CF and WACI – relate emissions to revenue or EVIC and are thus impacted by inflation and exchange rates. Inflation has an upward effect on revenue and EVIC, and *ceteris paribus*, feeds into a reduction in relative GHG metrics. If an investment portfolio contains assets denominated in several currencies, the exchange rate fluctuations may – depending on their direction – have a downward or an upward effect on relative GHG emissions (see DNB and Janssen et al., 2022).

Inflation and exchange rates may have non-negligible effects on trends in relative metrics and central banks are recommended to consider these effects when setting their net zero strategies. A study into the Dutch pension funds and insurers shows that using an adjustment based on a broad consumer price index and exchange rates significantly affects relative GHG emissions indicators (Janssen et al., 2022). The findings are summarised in the table below. For instance, over the period 2012-2019, the pension funds' unadjusted WACI showed a decrease of 34.4%, while the adjusted WACI decreased by 24.1%. Therefore, the adjustment shows that 10.3 percentage points of greening were "non-real". Thus, adjustment for inflation and exchange rates is recommended so carbon metrics reflect real developments.

There is not yet a harmonised approach to correct for inflation and foreign exchange fluctuations. An inflation adjustment based on a broad consumer price index may not fully capture sector specific developments, such as energy companies benefiting from higher electricity prices. It may be more accurate to use industry specific deflators, such as Producer Price Index (PPI) deflators. Furthermore, physical carbon intensity metrics that measure absolute GHG emissions per unit of output (e.g., emission per tonnes of steel) are not affected by inflation and can complement the information provided by the CF, WACI and CI. Such output measures, however, can only be used to compare companies in the same sector.

Guidance on correcting carbon metrics for inflation is still mixed. Currently, PCAF does not recommend adjusting for the impact of inflation in the calculation of metrics to maintain comparability across institutions, while emphasising that the topic should be scrutinized in the future due to its high relevance for the calibration of interim targets. EU climate benchmark regulation prescribes a general "enterprise value inflation adjustment factor" which does not distinguish between the causes of fluctuations in enterprise values.

Table **Average reductions in relative carbon metrics, adjusted and unadjusted (2012-2019)**

	Pension Funds		Insurance Companies	
Metric	**Unadjusted**	**Adjusted**	**Unadjusted**	**Adjusted**
CF	52.4%	44.9%	51.8%	46.7%
WACI	34.4%	24.1%	31.0%	23.7%
CI	23.9%	13.6%	22.5%	15.1%

Box 2

Firm-level emissions data

The majority of corporate GHG emissions data offered by specialized data providers is sourced from the Carbon Disclosure Project (CDP) and follows guidance from the GHG Protocol. Thousands of companies voluntarily report into this initiative via extensive questionnaires. The CDP assesses the quality of the information by using models to fill data gaps. The questionnaires and reports used by the CDP are based on the GHG Protocol, which provides guidance for companies on how to disclose and/or calculate GHG emissions. It is the most widely used framework for carbon accounting.

For firms not subjected to reporting obligations (most SMEs), GHG emissions data are heterogeneous across providers, especially if a large share of the data points is estimated. To gain a better understanding of the data, the Dutch Central Bank compared GHG emissions data from three different data. When assessing comparability of scope 1 and 2 GHG emissions of corporates included in the MSCI World Index, it shows that observations deviate substantially across data providers as methodologies used to estimate missing values tend to differ (Nguyen, 2022). The number of data points that is fully comparable between providers varies between 35% to 50% for scope 1&2, and2 and reduces to less than 20% for scope 3. When only looking at reported carbon data, the consistency level improves substantially: a respective 60% to 80% of data points is now comparable. Two out of the three data providers follow a methodology based on the GHG Protocol and appear to generate more similar data points, while the third uses a proprietary carbon accounting methodology.

Most large-sized firms currently only report on Scope 1 and 2 GHG emissions, but public pressure to report on scope 3 GHG emissions is mounting. Calculating scope 3 emissions may be expensive or complex, especially for large multi-product firms, because such indirect emissions are activity- and product-specific. As a result, investors often rely on estimations provided by data providers, which are generated based on different approaches, assumptions and input data. In addition, data providers often jointly distribute reported and estimated emissions in an attempt to improve their coverage level. This reduces transparency.

Various initiatives aim to increase reporting on scope 3 emissions, such as the Carbon Disclosure Project Supply Chain programme. Under this initiative, firms that wish to be recognised as climate transition leaders need to set a Scope 3 target and disclose their emissions if they are involved in the sale or distribution of fossil fuel products or if scope 3 emissions are deemed material. Furthermore, institutional investor' alliances are calling on their participants and issuers to adopt decarbonisation strategies that encompass (wherever material) Scope 3 emissions consistent with reaching Net Zero by 2050.

2.3 Carbon metrics based on forward-looking data

Forward-looking indicators help to foster a good understanding of net zero trajectories. While different metrics are being developed by data providers in the light of the growing interest for transition plans, there is limited availability of comparable and science-based forward-looking information, such as targets, commitments, and emissions pathways, that are needed to assess physical and transition risks (NGFS, 2022c).

Moreover, forward-looking indicators are sensitive to underlying assumptions and methodologies and are generally subject to greater levels of uncertainty compared to the backward-looking indicators. Both quantitative and qualitative data points may provide information on the extent to which a company already aligns or is expected to align with a net zero trajectory. A few types of forward-looking data points that can be used in a net zero approach: net zero or decarbonisation plans, carbon transition score, carbon budget, climate value at risk, and implied temperature rise.

2.3.1 Ways to use forward-looking data

Quantitative and qualitative assessment of net zero ambitions

Qualitative climate strategy assessments look at a company's net zero ambitions, and quality of communicated reduction targets. Various data providers publish qualitative metrics and rank corporate reduction targets along the categories "No Target," "Non-Ambitious Target," "Ambitious Target," "Committed Science Based Target (SBT)," "Approved SBT." The IIGCC Net Zero Investor Framework provides a high-level framework based on 10 qualitative criteria for the alignment assessment of companies, and their net zero transition plans. These qualitative criteria include, amongst others, target setting, disclosure, decarbonisation strategy, as well as climate governance and climate policy engagement[18].

Carbon transition score

This indicator qualifies companies as leaders or laggards with regard to risks and opportunities arising from the transition to a low-carbon economy, by means of a categorical classification or a score (0-10). For example, the worst category ("stranded assets") includes companies whose activities are incompatible with a low-emission economy, while the best risk category ("solutions") includes those offering products that enable the transition, such as electric cars or the production of energy from renewable sources. In between, there are intermediary classes such as "transition product", "transition operational" and "neutral". Furthermore, the quality of transition risk management is assessed and scored based on a number of company-specific features, such as company policies, governance structures, risk management programs and initiatives, targets and performance and involvement in any controversies, to name only a few. The final score is the output of this assessment procedure[19].

Climate Value at Risk

Climate Value at Risk (VaR) is a quantitative measure following a market-based valuation and assesses how climate-related risks and opportunities could affect company or portfolio valuations. It measures the percentage change in a company's market value resulting from the potential effects of climate change[20]. The quantitative model could consider : i) policy risks stemming from the changes in climate policies according to the Nationally Determined Contributions and their estimated sectoral breakdown, where impact variables are provided by the scenario forecasts; ii) the technological opportunities stemming from the low-carbon transition, quantified on the basis of green revenue share and green patents; iii) physical risks, i.e. the cost of the disruption of production due to either acute climate events (such as cyclones and floods) or chronic events (such as higher temperatures and greater rainfall) or the opportunities deriving from lower exposure to these risks.

The models may provide estimates of Climate VaR from both transition and physical risks. They are calculated according to different climate scenarios and Integrated Assessment Models (IAMs). The metric is expressed in a monetary value, and thus easily understandable and usable for investors. At the same time, the sophistication of IAMs make the metric complex to handle, not easily customisable and sensitive to the scenario assumptions.

Carbon budget overshoot

Quantitative overshoot metrics compare a company's projected and budgeted carbon emissions. Companies' projected emissions are calculated based on their emissions track record, stated reduction targets, and other data. The carbon budget estimates how much the world can emit and, by extension, how much a company can emit (across scopes 1, 2 and 3) and remain within the limitations required to meet a 1.5° or 2 °C warming scenario by 2100.

18 The framework distinguishes between companies that are "Not aligned", "Committed to aligning", "Aligning", "Aligned" and "Achieving net zero". For example, companies that are "Aligning" have set a short- or medium-term target, formulated a plan on how to meet these targets, and disclosed scope 1 and 2 emissions as well as material scope 3 emissions. See IGCC-corporate-transition-plan-investor-expectations.pdf for an overview of all 10 criteria including how to factor in transition plans.

19 See: MSCI Climate Change Indexes Methodology.

20 This metric differs from the usual meaning of the conditional value at risk (cVaR, or equivalently Expected Shortfall, ES) which quantifies the amount of tail risk within an investment portfolio, or the average expected return for returns below a specified percentile of the distribution of returns.

The estimation of a firm's budgeted carbon emissions often follows from IPCC guidance or scenario analyses. Different scenarios are used by data providers, including the scenarios of the IEA or the International Renewable Energy Agency (IRENA) (TCFD, 2017). A company whose projected emissions are below budget can be said to "undershoot", while those whose projected emissions exceed the budget "overshoot". There is good coverage on this metric for corporate issuers; yearly projections over a 30-year period allow for constructing forward-looking indicators. Still, accessing and understanding the data is not trivial. There is generally not a comprehensive document describing all the variables available and all the methodological steps made to construct them.

Implied temperature rise

The implied temperature rise (ITR) is a quantitative measure that can be used to assess the extent to which a company or a portfolio aligns with global climate targets. The ITR expresses the increase in global temperature in degrees Celsius (°C) that would occur at the beginning of the next century if the whole economy performed in a similar way to that firm in terms of overshooting or undershooting the carbon budget necessary to keep the global temperature below 2 °C. An ITR below 1.5 °C tells investors that the firm/portfolio is expected to be on track to reduce emissions sufficiently. The methodology looks at the forecasted carbon emissions of a company over time, based on their respective targets (i.e., the projected carbon emissions). It compares this to a sector- and region-specific target trajectory. The measure can be used for different asset classes.

CDP and WWF provide an open source methodology to translate the ambition of corporate GHG emissions reductions into temperature ratings at the firm and portfolio level (CDP & WWF, 2020). The methodology includes three steps: a target protocol, which converts individual emissions targets to temperatures, a company protocol, which aggregates these targets into an overall company score, and a portfolio protocol, which weights these company scores across an investment portfolio**.** To convert individual emissions targets into temperatures, the target protocol uses climate scenarios from the IPCC Special Report on 1.5 °C scenario database. Since companies have multiple targets, this data is then aggregated into company-level scores. At the portfolio level, these company scores are weighted to assess an index or portfolio of companies (several weighting options have been proposed). Companies that do not have relevant, publicly disclosed emissions targets are assigned a default temperature score, which assumes a business-as-usual temperature pathway. This enables company-by-company and portfolio comparisons.

2.3.2 Pros and cons of forward-looking data

Forward-looking climate metrics have clear advantages, especially when used in combination with backward-looking metrics. For a full view on climate transition risk, it is necessary to look beyond historical GHG emissions reductions and assess how likely it is that a company can make the transition in time. Even a company with a large carbon footprint may be well positioned to avoid carbon pricing risks if it's carrying out an ambitious and credible transition plan. According to the FSB, forward-looking metrics can help capture uncertainty and potential tail risks concerning the impact of climate change on both non-financial and financial firms (FSB, 2021).

Various data points can help in making this forward-looking assessment. One important component to consider is the quality of a companies' climate risk management, which can be assessed through the quality of existing climate policies, targets and governance structures. In addition, the various quantitative forward-looking metrics give a good indication of a company's estimated climate risk exposure, especially when used for benchmarking firms in the same industry.

At the same time, forward-looking portfolio metrics may have limited information value when assessed in isolation, as they suffer from various issues:

Uncertainty. Forward-looking measures estimate a company's projected GHG emissions under different scenarios. Uncertainty concerning the nature and magnitude of climate-related risks, combined with their non-linearity, long time horizon and interaction with the macroeconomy, underlines the importance of data that support forward-looking assessments of risk, including those obtained from scenario analysis (FSB, 2022). At the same time, these types of analyses may feed into inconsistent outcomes, especially when the underlying scenarios and assumptions are not fully harmonised.

At this point in time, there is still limited availability of standardised and comparable science-based forward-looking information across firms and jurisdictions that provides good information on tail risk of exposures to climate-related risks (FSB, 2021; NGFS, 2022c).

Methodology inconsistency. Forward-looking metrics vary both in their choice of input data (e.g., scope 1/2/3 emissions) and in their methodologies (including whether these estimated changes in emissions are based on firm, or sector/jurisdiction-level targets). These differences result in substantial variation in estimates of climate-related risks across firms, activities and jurisdictions (FSB, 2021).

Time inconsistency. Companies' carbon reduction targets and plans are used as an input for the projected carbon emissions. Data providers generally assume that these targets will be met, and do not rebase their projections on a regular basis. As a result, companies that set ambitious carbon reduction targets, which they eventually fail to meet, could end up being favoured over companies that set more conservative targets, which they actually meet.

Complexity. The Climate VaR, carbon budget overshoot and ITR metrics are dependent upon the underlying climate scenarios, and the final metrics are the results of complex modelling techniques. While the outcome of the models may be intuitive and easily understandable for investors, the underlying methodology is often opaque and sensitive to scenario assumptions. Furthermore, comprehensive documentation describing all the variables used in the modelling approach, as well as all the steps followed to construct them, is often missing.

Key take aways for central banks (data and metrics)

1. Pull in GHG emissions data from different sources, whenever it is viable, to assess consistency between data providers. Perform regular sanity checks on the provided data.
2. Choose data providers with a robust methodology for estimating missing data (scope 1, 2 and 3). Ideally aligned with guidance from the GHG protocol.
3. Include at least scope 1+2 emissions for target setting and phase in scope 3, starting with upstream categories and critical sectors.
4. Use a combination of backward- and forward-looking data points to get a robust picture on net zero trajectory alignment.
5. Perform an attribution analysis to assess what drives the reduction in the portfolio's carbon emissions over time in order to filter out monetary, economic cycle and financial effects from the actual reduction in GHG emissions.
6. Consider incorporating inflation and foreign exchange effects in climate-related disclosures to adjust for confounding trends in CF and WACI, or reporting physical carbon intensities for the most critical sectors.
7. Complement quantitative forward-looking metrics with qualitative assessment of corporate transition plans.

3. Modalities of net zero investment: how to design investment strategies?

Net zero strategies for corporate portfolios are often multifaceted, including targets on decarbonisation rate and pathways, as well as investment in climate solutions. Carbon reduction paths are implemented at the portfolio level with the aim to reduce the portfolio's overall carbon footprint over time. The required pace of decarbonisation for the entire portfolio may be implemented through sector-specific decarbonisation targets and may depend on a number of factors. For high emitting sectors pathways are provided via various initiatives, including the Transition Pathway Initiative (TPI), the Climate Action 100+ and the Science Based Targets initiative (SBTi). Climate solutions refer to products and services that enable emission reduction for the real economy. Targets for investing in climate solutions are generally formulated as a dedicated allocation (in % of assets under management) to companies or projects with a high share of so-called green revenues or capex[21].

Central banks that aim at both hedging carbon risk and facilitating the energy transition pursue both progress in the real economy and achievement of portfolio objectives. Such approaches would therefore be in line with the double materiality concept. Portfolio construction can help to reduce risk exposure, for instance by tilting towards best-in-class firms and/or selective divestment. Excluding carbon-intensive firms helps to hedge the central bank's portfolio against stranded assets but does not necessarily incentivise firms to reduce their GHG emissions. Staying invested and conducting stewardship, for instance by engaging on the reliability of companies' transition plans, may lead to more progress in the real economy. Investing in high quality green bonds, for which the proceeds are used to finance environmental projects or in renewable energy companies, can be considered as well as investments in climate solutions. These three broad types of net zero investment modalities are not mutually exclusive and can be considered jointly. The following subsections discuss each of these modalities with a focus on the relevance for central banks.

3.1 Portfolio construction

Corporate portfolio construction consists of changing the composition of securities to favour sectors and companies that are low emitters and allocate investment funds to those that reduce their carbon emissions over time. Some high emitting companies can be excluded ex ante and some fine tuning through positive and negative tilting of companies'/ sectors' weights in a portfolio can also be applied.

3.1.1 Exclusion and divestment

Exclusions and divestments of high emitting firms without credible transition plans are rather coarse means to hedge a central bank's portfolio against climate-related risk. Companies whose primary activity or conduct is no longer compatible with a credible pathway towards net zero could be excluded from the investment universe, considering relevant timelines.

A set of exclusion rules may provide a framework for setting minimum standards for investees in the portfolios, and signal which products and activities do not contribute to net zero investment objectives. Minimum standards can go beyond climate-related concerns, covering negative impact on the environment or society at large, for instance taking into account pollution or other sustainability or social goals (e.g., human right violations).

Sectors whose primary activity is not well suited to net zero objectives can be identified using well-established investor frameworks. Such frameworks help to define exclusions in a consistent and objective manner. Various net zero investor frameworks include guidance on company exclusion:

- **The IIGCC Net Zero Investment Framework[22]** advises that investors should not allocate additional capital to companies which are planning or constructing new

21 The EU taxonomy is an example of a framework to assess the contribution of economic activities, through revenues, to environmental objectives. These targets can be met via a combination of approaches, including portfolio construction, stewardship, and thematic investments.

22 See: PAII-Net-Zero-Investment-Framework_Implementation-Guide.pdf (parisalignedinvestment.org). Launched in May 2019, the Paris Aligned Investment Initiative (PAII) is a collaboration involving over 70 asset owners and asset managers managing more than USD 16 trillion in assets, led by IIGCC. APG and the Church of England Pension Board act as co-chairs of PAII and together with six additional asset owners (TPT Retirement Solutions, PKA, PGGM, Brunel Pension Partnership, RPMI Railpen and Lloyds Banking Group Pensions) make up the PAII steering group.

thermal coal projects and associated infrastructure (power, mining) or taking forward new exploitation of tar sands.

- **The EU's Paris Aligned Benchmark framework (PAB)** uses three types of exclusions: 1) norms-based; 2) product-based; and 3) activity-based. The first category consists of companies that violate the UN Global Compact and/or OECD guidelines for multinational enterprises. The second category contains companies involved in activities related to controversial weapons or in the cultivation and production of tobacco. The third category relates to companies that generate a large share of their revenues from, for example, the exploration, mining, extraction, distribution or refining of fossil fuels[23].
- **The Science Based Targets Initiative** recommends that financial institutions phase out financial support to coal across all their activities in line with a full phase-out of coal by 2030 globally, within six months from the time of SBTI target approval.

At a sector level, investors are taking steps to exclude coal and unconventional oil and gas from their investment universe, while exclusion of conventional fossil fuels is less common. The coal policy tracking tool developed by Reclaim Finance[24], a non-governmental research and campaigning organisation, shows an expansion of coal exit plans among global financial institutions. The exclusion is based on a set of criteria[25]. Other controversial exploration activities, such as oil sands and arctic drilling, are also excluded more often by investors. Various central banks have also formulated thresholds for (thermal) coal exclusion, including Banque de France, Swiss National Bank, Bank of Finland, and Monetary Authority of Singapore[26]. As regards conventional fossil fuels, however, analysis is usually done on a case-by-case basis, considering various criteria, such as the hydrocarbon reserves still held by the companies, their capital expenditure on new production fields, their methane emissions, or their anti-regulation lobbying activities, as well as transition plans[27]. NGOs have been calling upon signatories of the GFANZ sectoral alliances to better act on their "No new coal policies", and to also withdraw support from companies expanding oil and gas expansion and ensure that they phase out fossil fuels on low- or no-overshoot 1.5 °C trajectories (WWF, 2022b; GFANZ, 2022c). Furthermore, many leading NGOs, including the WWF, UNEP Finance Initiative and Greenpeace have explicitly called central banks around the world to stop investing in companies and sub-sectors that are considered "always environmentally harmful". These include companies that are expanding coal, oil and/or gas production.

Divestment from individual firms may be a consequence of the associated climate-related financial risk, or as an escalation measure following unsuccessful engagement. The literature is inconclusive as regards the price impact of exclusion and divestment. But a few new papers have provided evidence on the higher cost of funding or lower price when a stock is excluded from a passive investor's portfolio (Cheng et al., 2023). In addition, when a large enough number of investors implement similar divestment strategies, the collective action can reinforce real world effects on a company's access to capital (Pastor et al., 2021; Becht et al., 2023; Green & Vallee, 2023), although some adverse consequences could arise in terms of hurdles for transition financing (Hartzmark and Shue, 2022) and carbon leakage (Duchin, Gao and Xu, 2023).

Some asset managers choose to divest from the most carbon-intensive issuers per sector. Highly polluting companies that are unable to make the transition are also typically prone to higher risk of stranded assets. Divesting from these companies thus reduces the underlying climate risk

23 Under the EU PAB framework, revenue thresholds lie at 1% or more for hard coal and lignite, 10% or more for oil fuels, 50% or more for gaseous fuels. Companies that derive 50% or more of their revenues from electricity generation with a GHG intensity of more than 100 g CO_2 e/kWh also need to be excluded.

24 Exit coal for good – Reclaim Finance.

25 The Global Coal Exit List (GCEL), administered by the German NGO Urgewald, is the benchmark for coal exclusions. Companies on the GCEL represent 90% of the world's thermal coal production and the world's coal-fired capacity. It offers key statistics on over 1,000 parent companies and over 1,800 subsidiaries operating along the thermal coal value chain. The list is built on three criteria: relative criteria, absolute criteria, and expansion criteria. Home | Global Coal Exit List.

26 MAS has a coal-related policy, and excludes equities and corporate bonds of companies which derive more than 10% of their revenues from thermal coal mining and oil sands activities; Banque de France excludes from investments, companies that derive over 2% of their revenue from coal; Swiss National Bank excludes "from its portfolios all companies primarily active in the mining of coal for energy use"; Bank of Finland restricts direct investments in individual companies whose turnover exceeds 2% from thermal coal, 5% from the energy use of coal, 10% from oil drilling, 40% from gas production.

27 See: Novethic_2021_Exclusion-of-fossil-fuels.pdf.

at the portfolio level. Such targeted exclusion of the most carbon-intensive issuers per sector also allows to keep the sectoral exposures similar to the ones of the market portfolio.

3.1.2 Tilting allocation weights in portfolios

Among the net zero investment strategies, central banks can consider corporate portfolio alignment by changing the security weights vis-a-vis a benchmark in two ways. First, to reduce their climate risk exposure, investors underweight – for instance compared to their market capitalisation – those companies that are more exposed to transition or physical risk, as gauged by backward- or forward-looking climate-related metrics (see Section 2). Second, they can overweigh companies that are climate leaders. Such companies could, for example, be well-positioned to make a positive climate impact and harness potential climate transition opportunities stemming from enhanced climate regulation, technical innovation or changing consumer preferences.

The weighting approach can be applied by using a combination of issuer and sector data. Focusing solely on issuer-level data can lead to a reduction of a portfolio's exposure to entire sectors that are still pivotal in the economy (e.g., the energy sector). This could prevent investors from not only seizing transition opportunities but providing the capital necessary for the transition. Furthermore, the real economy benefits in terms of carbon reduction are uncertain and the improvement of a portfolio's climate-related indicators could turn out to be short-sighted. Tilting within sectors can help to maintain 'market neutrality' and directly affect the relative funding costs of green and brown firms within the same sector. Other frameworks use a combination of issuer-level and sectoral data. The European Central Bank, for instance uses this tilting approach in the corporate sector purchase programme and the pandemic emergency purchase programme.

Weighting or tilting also requires some reflections on how to benchmark corporate issuers. In the NGFS' sustainable and responsible investment guide (NGFS, 2019b), a best-in-class approach is proposed, which is defined as a broad strategy that involves either positive screening or index-adjusted weighting, also referred to as ESG tilting, by comparing the ESG characteristics of a firm to those of its peers. Firms can be selected or reweighted based on (i) a best-in-sector approach (ESG leaders within the same sector), (ii) a best-in-progress approach (also referred to as ESG momentum), or (iii) a best-in-universe approach (only the highest-ranking firms, regardless of the sector).

Tilting approaches, like net zero strategies, will evolve over time as new metrics are adopted, and data quality and knowledge improve. Investors face a difficult situation where action is urgently needed from a climate perspective, but where definitions and frameworks are not mature yet, and specific climate-related data are missing or incomplete. Some recent academic papers hint to potential pitfalls of the most used carbon metrics, like financed emissions, and of the focus on percentage reductions in emissions, which could fall short to achieve significant risk mitigation and real world portfolio decarbonisation (the carbon leakage problem). Therefore, further research is warranted to suggest alternative means to align more effectively investors' portfolios with the transition to a low-carbon economy (Fraser and Fiedler, 2023; Hartzmark and Shue, 2022). Under these conditions, weighting strategies will be dynamic depending on the progress of the actual decarbonisation and the state-of-the-art in climate investing.

Compared to traditional investment frameworks adopted by central banks, net zero portfolios could imply higher complexity and tracking error. Positive and negative tilting could be based on a combination of backward and forward-looking metrics that can provide mixed signals and could entail time horizon trade-offs in the net zero emissions pathways (e.g., when high emitting firms show the potential of remarkable reduction). Corporate transition plans also provide useful inputs for portfolio decarbonisation (See Box 3). Therefore, portfolio construction is a complex multi-faceted optimisation exercise. Moreover, the compromise between different net zero dimensions and a high heterogeneity in the ambition of investors could result in significant divergences between market- and net zero portfolios. This situation could result in a disconnect between market- and net zero portfolios with potential trade-off between traditional investment objectives (return, risk, liquidity) and decarbonisation objectives. A sound investment strategy should be prepared to deal with such trade-offs, should they arise. In other words, the investor should ideally decide in advance what to do in case the decarbonisation objective happens to conflict with the tracking error objective – or with other objectives of the investment process (Angelini, 2024).

Box 3

Corporate transition plans

Central banks need to rely on relevant metrics to design net zero investment modalities. Section 2 discussed many quantitative metrics based on backward- and forward-looking data. Credible transition plans also provide much useful information as regards companies' net zero commitments for central banks' portfolio construction. In 2022 the number of SBTi commitments doubled to reach 2,400, with over 1,600 companies having agreed to set a net zero target. Transition plans are crucial, however, to assess the feasibility of climate targets and the progress towards them. A 2023 CDP analysis shows that while companies are recognising the need for climate transition plans, more effort is needed to develop and disclose credible plans.

Several initiatives identify key components of a transition plan that is credible, decision-useful, and comparable. While there are no international standards yet for disclosing transition plans, some national and supra-national initiatives are ongoing. For example, the EU envisages mandatory disclosure of transition plans through the Corporate Sustainability Due Diligence Directive and the Corporate Sustainability Reporting Directive, the US SEC through climate disclosure regulation, and the UK has set up the Transition Plan Taskforce (TPT) to develop a standard for private sector climate transition plans. International initiatives on transition plans comprise the FSB-TCFD guidance and ISSB exposure drafts, along with industry-led endeavours (e.g., GFANZ and IIGCC among others). A key element to ensure credibility and feasibility of the plans is the external review and validation of transition plans by independent parties, such as SBTi. These good practices suggest companies to disclose:

i) comprehensive short-medium and long term GHG reduction targets,
ii) credible decarbonisation strategy,
iii) commitments to capital and operational expenses for the transition and investment in green solutions,
iv) pledges to phase out fossil fuel use and production,
v) climate governance,
vi) executive compensation and climate-related incentives.

In a broader approach, the corporate net zero commitment needs to cover the whole supply chain and consider the relevant just transition principles (Climate Action 100+, 2021).

A crucial information for the investor's assessment of a transition plan is the corporate capital and operational expense planning, that eases investor to understand and assess the corporate ambition and commitment.

The analysis of transition plans needs to consider sector-specific features, to enable investment strategy to be sector neutral. First, the assessment should consider the differences in the design of transition plans between financial and non-financial corporate holdings provided that central banks may have both types in portfolio either as direct investment or via equity ETF/funds. The transition plans of non-financial firms are designed at corporate-level, while financial firms transition plans refer to their exposure to high carbon intensive sectors (e.g., energy, transport, industrials and materials, etc.) by using industry-specific decarbonisation assumptions, e.g. those of the IEA net zero scenarios (as suggested by Net Zero Banking Alliance). Going forward, corporates' transition plans should ideally play a role in financial intermediaries' transition plans. Second, the investors' evaluation of transition plans needs to compare different metrics across high emitting sectors that need to decarbonise at a faster pace than others. Therefore, it requires sectoral comparison to assess different target metrics, such as GHG-related data points formulated in terms of gCO_2/km in the transport sector, or tCO_2e/tonne for materials sector, or gCO_2/kWh for energy sector. It also needs to envisage technological innovation changes and the sector net zero scenario assumptions (e.g., IEA, 2020, UNEP FI, 2020, TPI, 2022).

Investors can perform the assessment of transition plans in several ways. For instance, by comparing a firm with sector peers or by measuring its alignment with net zero benchmark pathways (IIGCC, 2023). The selection of a climate benchmark entails critical assumptions, as it can be derived from absolute emissions budgets, or it can be sector-based or sector-neutral (as developed by SBTi).

…/…

The benchmark divergence metric can refer to specific points in time or to an overall pathway. The latter can capture the relative performance in a more accurate and representative way, but it is more complicate to compute and communicate.

As transition plans are forward-looking tools for investors, it is necessary to monitor actual achievements and analyse potential deviations. This allows (i) to track progress of the firm commitments against net zero and intermediate commitments, (ii) to weigh modest carbon reductions vis-à-vis intermediate targets and peer carbon performance, (ii) to update their assessment based on most recent scenarios and up-to-date technologies versus nascent innovations, (iii) to consider the extent of the emission reductions and carbon offsetting. Moreover, central banks may assess the feasibility of past corporate commitments in the light of contingencies (e.g., the energy crisis) and adjust central banks' own net zero strategies for investment portfolios. Decision-making processes, such as transition plans, can be strengthened by combining with a stewardship approach. Ultimately, the credibility of investor and central bank's decarbonisation pledges hinges on the quality of corporate transition plans.

3.1.3 Climate benchmarks

Climate benchmarks can be a powerful aspect of a net zero investment strategy, informing portfolio construction. They offer a ready-to-use tool for asset allocation to reduce financed emissions. In addition, climate benchmarks may reduce climate-related risks and provide an increased exposure to opportunities arising from the transition, such as through higher shares of green revenues compared to parent index. In that case, "green" could, for example, be defined as substantially contributing to one or more of the environmental objectives without significant harm[28], based on the EU taxonomy. A benchmark with a transparent, science-based methodology helps prevent greenwashing, and its implementation and related communication can support the transition.

A climate benchmark incorporates specific objectives on GHG emissions reductions and the transition pathway to a low carbon economy through the selection and weighting of underlying constituents. Both passive and active investors can benefit from climate benchmarks that balance the objective of real economy emission reductions with an adequate investable universe compared to traditional benchmarks. For example, for a passive investment strategy, such benchmarks can help to track closely the financial performance of a "business-as-usual" benchmark while generating steady decarbonisation benefits (Andersson et al., 2016; Bolton & Kacperczuk, 2021; Jondeau et al., 2021; Chen et al., 2022). Climate benchmarks typically incorporate decarbonisation targets and strategies that have been discussed earlier in the technical document, especially exclusion and tilting, and can factor in climate transition actions of the constituents, such as investments in climate solutions. While net zero benchmarks currently exist for equity and fixed income, those for the former are most advanced, particularly compared to benchmarks for sovereign bonds (IIGCC, 2023).

New regulations, growing demand and technical feasibility are boosting the emergence of climate benchmarks. The regulation on EU climate benchmarks specifies disclosure and alignment requirements for index administrators aiming to align with the EU Climate Transition Benchmark (CTB) or EU Paris-Aligned Benchmark (PAB)[29]. The methodologies of both benchmarks are based on comments laid down in the Paris Agreement, requiring the use of the 1.5 °C scenario, with no or limited overshoots. The CTB and PAB pursue similar objectives, such as protecting assets against climate related risks and financing climate solutions. But the PAB has a stronger ambition. This is for example expressed in a higher initial GHG intensity reduction compared to the investment universe (50% for the PAB versus 30% for the CTB). Furthermore, PABs have fossil fuels exclusion requirements. The EU PABs are designed for investors that want to be at the forefront of the immediate transition towards a +1.5 °C scenario.

28 Article 3 Regulation (EU) 2020/852 of the European Parliament and of the council of 18 June 2020.

29 See Regulation (EU) 2019/2089EN https://finance.ec.europa.eu/regulation-and-supervision/financial-services-legislation/implementing-and-delegated-acts/eu-climate-transition-benchmarks-regulation.

Table 2 **Overview of selected climate benchmark decarbonisation drivers, methodologies, examples**

Decarbonisation driver	Methodology	Example
Fixed rate	Built-in decarbonisation rate will determine a minimum decarbonisation trajectory by over- and under-weighting companies.	EU PAB/CTB
Disclosure indicators and alignment assessments	Measurement of company progress against the initiative's three high-level goals: emissions reduction, governance, and disclosure. The Benchmark tracks business alignment with a net zero emissions future and the Paris Agreement goal of limiting global temperature rise to 1.5 °C against a number of key disclosure indicators and alignment assessments.	Climate Action 100+ Net Zero Company Benchmark
Implied Temperature Rise	Designed benchmark to be aligned with a 1.5 ˚C Implied Temperature Rise through the implementation of decarbonisation over time.	MSCI
Carbon budget	Consideration of the cost of time, by adjusting the decarbonisation rate depending on the starting date to reflect the remaining carbon budget to achieve the Paris Agreement objectives.	S&P
Transition	Focus on financing the carbon transition in emission-intensive companies and transition leaders. Select companies in the top half of every sector that are effectively tackling their emissions, based on current and forward-looking climate indicators. Engage to steer companies to net zero and only divest if the headline and stranded asset risk is too high.	MSCI Climate Action Indexes[1]

1 Climate Action Indexes – MSCI.

Asset managers are increasingly offering investment solutions involving climate benchmarks. While these approaches are often overlapping, the underlying perspectives on decarbonisation can differ (see Table 2).

While climate benchmarks bring clear benefits from a decarbonisation perspective, their adoption may face hurdles. For example, it can be challenging for investors to ensure the initial GHG emissions reduction and annual self-decarbonisation, while satisfying their key portfolio management objectives on diversification and risk-adjusted return. This could, for instance, be expressed by fewer constituents or higher tracking error compared to alternative benchmarks that put less weight on climate data. As is the case more broadly in this space, lack of high-quality climate-related data across the investment universe could mean material portfolio rebalancing down the road when better data become available.

3.2 Stewardship

Stewardship is another important tool to drive net zero alignment[30]. It can help to effectively steer companies towards net zero through direct and indirect engagement and by exercising voting rights. Investors can directly engage with companies in a specific and detailed way according to their own beliefs and using their own policies. In contrast, with indirect engagement (via a manager), investors have limited choice in implementing specific stewardship[31] measures with companies. The threat of divestment can be used as a pressure mechanism and an escalation measure in the engagement process.

In general, three different types of engagement can be identified as follows. This document focuses on the latter two types:

1) **Policy engagement –** engage with policy makers and regulators, for instance via responding to consultations.
2) **Market engagement –** engage with market participants, such as external asset managers, credit rating agencies, data providers etc.

30 The Principles for Responsible Investments (PRI) defines this engagement process as "the use of influence by institutional investors to maximise overall long-term value including the value of common economic, social and environmental assets, on which returns and clients' and beneficiaries' interests depend." And according to the NZAOA, "conducting stewardship activities within investment portfolios is one of the most direct levers that investors can use to achieve real-world decarbonisation." (The Future of Investor Engagement: UN-convened Net Zero Asset Owner Alliance Investment Leadership Programme April 2022 A call for systematic stewardship to address systemic climate risk).

31 The IIGCC has launched its Net Zero Stewardship Toolkit, providing guidance to all type of investors to enhance their stewardship practices and deliver the rapid acceleration in decarbonisation by 2050. See https://www.iigcc.org/resource/iigcc-net-zero-stewardship-toolkit/.

3) **Corporate engagement –** engage with and vote on investee companies in the portfolio, either indirectly via an asset manager or directly by the central bank itself.

Several central banks pursue a policy engagement. Central banks and policy makers collectively engage in dialogue with market participants via international working groups. They publish research to stress the need for transparency, standardisation and harmonisation in sustainable and responsible investment approaches (within the NGFS where central banks are leading, at the BCBS, the FSB, OECD, UN and the G20 where central banks are active participants). Furthermore, it is common for central banks to respond to consultations on new sustainable finance regulation and/or updated national corporate governance codes etc.

Market engagement involves having dialogues with market participants within the broader ecosystem and specifically encouraging progress toward net zero commitments through external asset managers (UN PRI, 2024). Some central banks may invest in corporate securities via external funds, in this case they could use this engagement tool to implement a net zero investment strategy. For instance, the Monetary Authority of Singapore (MAS)[32] has established stewardship principles and set out expectations on external asset managers' activities and the investee companies (see **Figure 1**).

Corporate engagement entails dialogue and communication efforts with investees. Central Bank of Norway provides an example of a central bank with one of the largest corporate portfolios where an extensive stewardship activity is performed through voting and engagement. Building on stewardship principles, central banks could set expectations on their external asset managers in the areas related to investment and risk management activities, reporting processes, and to influence on portfolio companies (see **Table 3**).

Central banks could assess asset managers based on the above principles and expectations on a regular basis. They may also refer to these principles to inform their subsequent engagements. For example, external asset managers could be assessed on their process of integrating climate considerations into their investment process, the quality of disclosure, voting policies and their impact of engagement efforts on the portfolio's exposure to GHG emissions. When attempts to engage with an asset manager fail, reducing or terminating the investment relationship may be used as an escalation measure, amongst others.

The same set of considerations could be applied for asset engagement in which central banks directly manage their assets. Asset engagement requires delimiting the perimeter of investment assets, and the design of the engagement process depends largely on the level of direct control central banks can exert on the investees. Table 4 situates direct engagement among different approaches of asset engagement.

Figure 1 **Examples of stewardship practices**

32 MAS Sustainability Report 2021/2022.

Table 3 **Climate engagement objectives**

Internal investment and reporting processes	**Integrate climate change considerations into investment policies, frameworks, and strategy.** Asset managers should determine the materiality of companies to engage, set short- and long-term emissions targets for the portfolios that they manage, implement strong governance frameworks to ensure that their management is accountable for climate risks and clearly set out how such risks are managed. In addition, they should set out a clear escalation framework on their approach towards portfolio companies that are less responsive to engagement, with divestment as a possible last resort. **Integrate material climate change risks into risk management.** Asset managers should identify climate risks and consider relevant adaptation and mitigation measures taken by portfolio companies. Investor may want to make sure the investee takes charge of its value chain. Moreover, they should encourage portfolio companies to implement relevant procurement policies, engage with strategic suppliers and integrate the cost of carbon into how they manage their supply chains. **Monitor and disclose stewardship activities, deliverables and milestones regularly.** Asset managers should assess the impact of engagements and votes on shareholder resolutions and make regular disclosures of their activities and assessments.
Influence on portfolio companies	**Vote responsibly and conduct purposeful engagements with portfolio companies on material climate- and other ESG-related issues.** Asset managers should encourage portfolio companies to improve their ESG practices and make progress towards meeting their commitments and targets. **Encourage portfolio companies to disclose material climate-related information.** In line with the TCFD recommendations, asset managers should encourage portfolio companies to disclose the GHG emissions associated with their business operations and value chains in line with standards(Greenhouse Gas Protocol or other relevant industry or national standards). **Collaborate with like-minded investors, including other central banks, through collective engagement platforms.** Such collaboration can allow for a stronger voice in engaging companies.

Table 4 **Overview approaches to asset engagement**

Outsourcing	Level of control	Comment
Internally managed portfolios	High	• Assets follow central bank's own policy. • Ability to directly engage with investees and vote on shareholder meetings. • Divestment can be used as escalation.
Externally managed mandates (segregated mandates)	Medium	• Assets follow central bank's own investment policy. • Assets still placed at arm's length, where mandate manager is responsible for day-to-day execution. • Ability to (in)directly engage with investees and vote on shareholder meetings. • Divestment can be used as escalation.
Externally managed funds (commingled funds, pooled account)	Lower	• Assets placed at arm's length and follow policy of fund manager. • Only possible to indirectly engage with investees (follow manager's V&E policy). • During the manager selection process, however, investors can differentiate between V&E policies. • Divestment from individual investee not possible, but withdrawal from fund is possible as escalation.

Asset engagement efforts often concentrate on those companies that are either highly polluting and/or relatively exposed to climate risks. For many investors, resources are too limited to enter direct dialogue with all investee companies. Hence, aiming for maximum impact engagement efforts are often directed at companies that are highly polluting (e.g., approaches taken by Climate action 100+), at companies with relatively high climate risk (physical and/or transitional) and/or at companies to which the portfolio is highly exposed to. Central banks could inform and prioritise their stewardship activities setting expectations and engagement objectives in line with those abovementioned for the market engagement.

The PAII has formulated concrete guidelines, including on stewardship practices, for investors (asset managers and asset owners) that aim to align their portfolio to a net zero trajectory. It advises to set an engagement goal at portfolio level, which ensures that at least 70% of financed emissions in material sectors are either assessed as net zero, aligned with a net zero pathway, or the subject of direct or collective engagement and stewardship actions. This threshold should increase to at least 90% by 2030 at the latest. Investors should disclose the proportion that is considered net zero or aligned, disaggregated from the total (IIGCC, 2021). Based on PAII and other guiding commitments, the IIGCC has recently defined a toolkit to provide all types of investors with the foundational framework and guidance to enhance their stewardship practices to deliver the rapid acceleration in decarbonisation (IIGCC, 2022b). The toolkit specifically provides a core process aligned with the PAII recommended targets and stewardship actions to help investors implement their own net zero commitments.

Central banks that have a high to medium level of control over their corporate investment portfolios may consider formulating a voting and engagement (V&E) policy. The policy ensures transparency, objectivity, and predictability in the actions, serving as a safeguard against reputational risks. Among central banks, voting is the most adopted strategy whose complexity may be mitigated by a wide range of proxy voting services such as voting recommendations, automated voting and reporting. Nevertheless, a certain knowledge of the investees (either developed internally or via an investment manager) remains as a prerequisite for being able to make an informed voting decision. The main risks may arise from the involvement in shareholders' disputes on specific themes or casting votes inconsistent with the policy. Compared to voting, engagement entails a greater burden in terms of time, resources, and skills; indeed, for the dialogue to be effective, a deep knowledge of the engagement topics and the involved company is necessary. Legal risk may consist mainly in receiving privileged information but it can be appropriately mitigated through specific measures, while the reputational risk may derive from the public exposure implied by collaborative engagement (Fanari & Bernardini et al., 2024). Net zero frameworks require investors to set an engagement strategy with clear milestones and escalation measures (including targeted divestment) and to undertake voting and engagement to improve company performance against specific climate metrics.

Various tools can be used in the engagement process, including writing letters to explain rationale for engagement, co-filing and supporting relevant climate-related shareholder resolutions and/or escalation via voting, including voting against the board, remuneration policy, annual report and accounts[33]. Also, it is important that the escalation measures are connected to a feedback loop, so explicitly coupled to investment, weighting, and divestment decisions. By acting in a collaborative manner with other investors, via initiatives such as Climate Action 100+[34], stewardship becomes more impactful, both by means of the size of assets backing the initiative as well as the signal (of a collective direction of change) it sends[35]. With the *Climate Action 100+ Net Zero Company Benchmark* it is now possible to verify if companies are on the 1.5 °C pathway in a consistent and clear way. Investors can use the Net Zero Benchmark alignment within their stewardship approach and hold companies accountable[36].

33 Elevating Climate Diligence on Proxy Voting Approaches: A Foundation for Asset Owner Engagement of Asset Managers.

34 Climate Action 100+ is an investor-led initiative aiming to target the world's largest corporate greenhouse gas emitters to act. To this end, investors cooperate in collaborative engagements with other investors targeting these corporates. See: Climate Action 100+.

35 Dimson, Karakas and Li (2020) find several "secrets" of engagement success which support collaborative engagement, namely a two-tier strategy (lead and supporting investors, preferably with a domestic lead investor), and the involvement of influential investors with greater assets under management and larger aggregate holdings in the target company.

36 The Future of Investor Engagement: UN-convened Net Zero Asset Owner Alliance Investment Leadership Programme April 2022 A call for systematic stewardship to address systemic climate risk.

A stewardship approach has however potential limitations for central banks:

- **Legal policy mandate –** Stewardship should be designed in such a way that it does not undermine central banks' core tasks and objectives set out in the legal policy mandate. While engaging with companies can reduce real world emissions and may therefore lower financial stability risks related to climate change, not all central banks may have room to follow such an approach in all their portfolios. The characteristics of central banks' own-fund and/or pension fund portfolios tend to align best with a V&E approach.
- **Reputational risk –** Stewardship has most impact when full transparency is provided on V&E policy and voting records. However, as many central banks also fulfil supervisory practices and/or are extension of government, it may not be desirable to signal which individual companies fail to meet the central bank policy requirements. Other reputational risks could stem from controversial votes and could be criticized by any central bank stakeholder, either for supporting or rejecting an agenda item.
- **Risk of inconsistency –** When voting via different asset managers (based on their voting policies), inconsistent voting outcomes may arise. One asset manager may for instance deem a climate transition plan adequate, while another asset manager deems it insufficient. It would thus be preferable for central banks to monitor and identify where different voting outcomes come from, and to engage with asset managers to harmonize approaches following international frameworks.
- **Knowledge gap** – Capacity building for V&E is resource intensive. For one, because V&E requires specific knowledge on investee companies. In general, what constitutes good corporate behavior varies per jurisdiction and over time, as national corporate governance codes are updated regularly. Also, company specific initiatives, such as filed shareholder resolutions or company transition plans, often require in-depth assessments for which specialist knowledge is required (e.g. about competing technologies). For instance, companies are increasingly motivated to put climate transition plans up for advisory vote in the AGM, including via initiatives such as Say on Climate (also see table 2). Whenever the knowledge or resources are not sufficient, the proxy voting service is a valid solution that is widespread as a market practice. In particular, central banks can customise the proxy voting approach by defining voting guidelines which can be refined according to the monitoring of results and practices.
- **Directly engaging in a dialogue with corporates might expose the central bank to legal risks to be considered.** When engaging in a private dialogue with listed companies, risks of judicial controversies and legal infringements should be carefully monitored and mitigated.

3.3 Thematic investments

3.3.1 Green and other labelled bonds

Green bonds are the most common products for central banks' impact investing (NGFS, 2020a). On the instrument side, issuers can use existing frameworks to issue green and sustainability bonds, including climate bonds. Some frameworks, including the Climate Bond Initiative's Climate Bonds Standard, only allow for green bond proceeds to finance projects that align GHG emissions with the 1.5 °C scenario, while other standards, including the ICMA Green Bond Principles, allow for financing other important green projects that do not have such a direct emissions impact, e.g., by focusing on biodiversity.

Concerns remain whether issuing green bonds leads to a reduction of emissions at the issuer level. The 2020 NGFS Progress Report notes that corporate green bond issuance does not necessarily translate into a reduction in firm-level carbon intensity (NGFS, 2020a). Investors may thus need to undertake additional analysis, such as assessing impact reports or transition plans made available by issuers. Current second party verification and impact reporting do not address emissions at the firm level, requiring investors to do more due diligence, for example by using IIGCC's framework. The 2022 Transparency report tries to address the aforementioned shortcomings, in particular by noting TCFD guidelines and the establishment of the IFRS Foundation's International Sustainability Standards, which aim to develop international baseline reporting standards for climate-related financial disclosures (NGFS, 2022a). The auditing of green impact data on both the bond and issuer level remains key for improving credibility.

Making an adjustment for the GHG emissions impact of green bonds when measuring a portfolio's climate impact is challenging for both conceptual and practical reasons. First, most climate metrics are calculated using issuer level data, regardless of the type of bond held in the portfolio. So, while a project funded by a green bond

may have a positive impact on GHG emissions, it is likely not directly associable with the emissions of the issuer. As explained in the NGFS 2020 Progress Report, this gives rise to several issues and raises the question whether it would be legitimate to deduct saved emissions from the issuer's carbon footprint. Furthermore, any impact may already be implicitly reflected in carbon data, especially for forward-looking metrics such as Paris Alignment scores. Green bond investors may therefore treat green bonds in equivalent fashion to conventional bonds when performing such analyses, or to exclude them from GHG emissions calculations altogether. They may however wish to compute the aggregate emissions impact of green bonds at the portfolio level, including any emissions saved. Reporting such information separately from climate-related data at aggregate portfolio level helps avoid confusion.

Regardless of the treatment in the carbon footprint context, green bonds can have an important place in investors' net zero portfolios. For example, the IIGCC Net Zero Investment Framework explicitly mentions green bonds as a key investment tool in the context of climate solutions. Depending on the type of the portfolio and the associated investment constraints, they can also be an operationally efficient – and, possibly, the only available – means of integrating climate considerations into a portfolio, with manageable trade-offs vis-à-vis the traditional objectives of liquidity, safety and return. However, the proceeds of green bonds purchased toward this end should be geared towards climate mitigation activities, per the standards mentioned above (IIGCC, 2021).

In addition to green bonds, some central banks consider including other labelled bonds, especially outcome-based instruments, such as sustainability-linked bonds.

3.3.2 Other climate solutions

Next to green bonds, central banks can invest in other climate solutions, such as renewable energy infrastructure or private equity impact funds. Examples include pure play companies like wind power or solar firms, but also enabling companies that provide solutions to reduce energy usage. Beyond energy-related topics, climate solutions can be found across the economy, from regenerative agriculture, over carbon capture and storage to reforestation. Investment options could include direct investments in listed and unlisted assets, use of externally managed infrastructure funds, and blended finance structures.

Carbon offsets, or credits, are increasingly considered as part of net zero strategies, but caution is needed due to lack of transparency and standardisation. Carbon markets have been increasing in importance in the past years, especially since COP26 aimed to increase carbon pricing transparency and agree on a price of carbon. Carbon offsets, often used interchangeably with carbon credits, are tradable instruments usually reflecting the price of one tonne of carbon-equivalent emissions. These instruments are mostly either tradable allowances in a cap-and-trade scheme, or credits coming from carbon offsetting projects. In a cap-and-trade scheme, a government issues tradable allowances for companies, for example the EU Allowance contract[37]. Companies must then buy these contracts if they exceed their allowance while companies can sell contracts if they stay below their allowance. Governments can alter the allowances over time and thus influence the cost for carbon equivalent emissions for corporates. Carbon offsetting projects are activities that reduce or remove GHG emissions, such as a renewable energy generation project through windmills. Trading the credits linked to GHG emissions or removals from carbon offsetting projects faces issues as the market is fragmented. In addition, it is difficult to assess the credibility of the impact of the offsetting projects as well as the broader ESG issues surrounding some of these projects. This is an issue for investors as companies are increasingly using the offsets from projects to achieve their net zero goals. In addition, using carbon offsets means companies do not necessarily have to lower the emissions of their own operations to achieve net zero, slowing the transition on the ground. Voluntary and regulatory initiatives are ongoing to create more transparency and integrity in the carbon offset market (e.g., EU's Carbon Removal Certification Framework, Integrity Council for Voluntary Carbon Markets). Nonetheless, the carbon offset market is not mature yet. This should prompt investors to be vigilant when they see a bond issuer is using carbon offsets to reduce its carbon footprint.

37 See https://climate.ec.europa.eu/eu-action/eu-emissions-trading-system-eu-ets/emissions-cap-and-allowances_en.

Key take aways for central banks (net zero investment modalities)

1. Implement exclusion and/or positive/negative tilting based on a combination of evolving sector- and firm-specific assessments and metrics related to climate change and other ESG topics.
2. Perform due diligence on the emissions trajectory and the transition plans on the issuer level, in particular on short- and intermediate term actions and targets and on the issuer's use of carbon offsets.
3. Consider the use of climate benchmarks as a ready-to-use although not customizable implementation option.
4. Engage external asset managers on their investment and reporting processes and through their influence on portfolio companies.
5. Engage portfolio investee companies directly, where possible in a collaborative manner with other investors, covering immediate climate-related targets, transition plans and escalation measures.
6. Treat green bonds in a similar manner to conventional bonds when calculating a portfolio's climate impact (e.g., carbon footprint).
7. Monitor and report on the impact of green bond and climate solution holdings separately, e.g. disclosing removed or avoided emissions.
8. Consider adopting a double materiality perspective when designing a net zero investment strategy.
9. Consider that SRI is a new and rapidly evolving field, where trade-offs, snags and pitfalls need to be considered (portfolio decarbonisation may entail a sacrifice in terms of risk-return; decarbonisation policies might have unintended effects). Be wary of taking public commitments without a thorough analysis of their consequences.

4. Conclusion

The technical document explores possible tools and strategies for net zero alignment of portfolios of corporate securities held by central banks. The document leverages on market solutions and practices from some central banks to guide the central bank community in the design of strategies of corporate investments in line with central banks' decarbonisation objectives, wherever they apply.

As regards the investment perimeter, central banks can implement net zero investment policies first in their portfolios that are less constrained by institutional tasks and legal frameworks. Among them, central banks' own funds and pension fund portfolios have a more diversified composition, including corporate securities, and therefore are more suitable to integrate net zero considerations for either risk protection or positive impact or both.

Regarding data for net zero alignment, the array of metrics is increasingly rich and central banks can combine both backward- and forward-looking metrics in order to harness the benefits of more well-established methodologies and cover historical carbon emissions data as well as corporate transition plans and green investments. At the same time, it is necessary to address potential limitations of carbon metrics, such as poor quality and comparability. In this respect, central banks can encourage the most robust methodologies to estimate GHG emissions data, covering all scope 1, 2 and 3 emissions, and assess consistency between data providers. In the pathway to net zero, it is key to disentangle what drives the reduction in the portfolio's GHG emissions over time in order to filter out cyclical, inflationary and financial effects from the actual emissions reduction.

Net zero strategies for corporate securities portfolios are often multifaceted, including targets on decarbonisation pathways and investment in climate solutions. The former are implemented at the portfolio level with the aim to reduce the portfolio's overall carbon footprint over time. The climate solutions refer to products and services that enable emission reduction for the real economy. According to their institutional framework, central banks can combine three main strategies for net zero alignment of the corporate investment: portfolio construction, stewardship, and thematic investments. These strategies are not mutually exclusive and can be considered jointly.

Portfolio construction can help to reduce risk exposure, for instance by tilting towards best-in-class firms and/or selective divestment. Excluding carbon-intensive firms helps to hedge the central bank's portfolio against the risks of stranded assets but does not necessarily help reduce GHG emissions in the real economy unless exclusion entails permanently higher cost of funding for more polluting firms. Even in case it does, several factors may hinder that a real economy impact will follow. Implementing exclusion, positive/negative tilting with a combination of sector-specific and issuer-specific assessment can avoid a reduction of a portfolio's exposure to entire sectors that are still pivotal in the economy (e.g., energy, steel and cement sectors) and leaves room for seizing transition opportunities. Central banks' tilting approaches to decarbonisation goals may evolve over time as new metrics are adopted, and data quality and knowledge improve.

Central banks should be aware of the complexities and trade-offs involved in net zero portfolio construction. Incorporating climate-related considerations into portfolio management is a complex multi-faceted optimisation exercise, that could imply higher tracking error compared to traditional investment frameworks adopted by central banks. Moreover, the compromise between different net zero dimensions and a high heterogeneity in the preferences of investors could result in significant divergences between market and net zero portfolio, resulting in potential trade-offs between traditional investment objectives (return, risk, liquidity) and decarbonisation objective. A sound investment strategy should be prepared to deal with potential trade-offs between decarbonisation objective and the tracking error or other financial objectives. Climate benchmarks can be considered as ready-to-use implementable solutions for net zero investment. Moreover, investors need to be aware of carbon metrics pitfalls feeding into portfolio "paper decarbonisation" instead of risk mitigation or real word carbon reduction (the carbon leakage problem).

Stewardship could complement, for instance by engaging, where possible in a collaborative manner with other investors, covering immediate climate-related targets and transition plans may lead to more progress in the real economy. Engagement efforts can focus on those companies that are either highly polluting and/or relatively exposed to climate risks. Moreover, engagement with external asset managers on their investment and reporting processes and through their influence on portfolio companies may be useful. Central banks that have a high to medium level of control over their corporate investment portfolios may consider formulating a voting and engagement policy and using proxy voting services. This approach presents various complexities though, that need to be heeded.

Thematic investing could further encourage the issuance of green bonds and other labelled bonds for which the proceeds are earmarked for environmental projects, for instance investment in renewable energy. The success of labelled instruments depends on the reporting, monitoring and verification of the use of proceeds and their environmental impact.

Looking ahead, further experience sharing and coordination efforts will help the central bank community pursue net zero investments. Large heterogeneities exist among central banks as regards net zero investment strategies adopted, partly because of differences in objectives across jurisdictions and central banks portfolios. Experience sharing within the NGFS can showcase what has been done in different jurisdictions and provide evidence on the impact of net zero investments on central banks' financial returns and risk management. Some initiatives, such as tilting or voting and engagement, will be more powerful, if coordinated across central banks. In the future, central banks could, for instance, explore possibilities to set up a forum for discussion on engagement challenges and solutions, for those who wish to engage with corporate management. A harmonised approach supported and promoted by several central banks can create momentum and reduce, for individual central banks, reputational risk associated with voting and engagement. More broadly, novel net zero investment metrics and strategies are also likely to emerge should central banks have regular exchanges on this topic, among themselves and with market participants. Moreover, such collaborative efforts among central banks can also have a signalling effect, encouraging and inspiring action of other stakeholders towards greening the financial system.

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Appendix

Table A.1 **Sector-specific guidance**

Sector	Guidance	Tools/Examples
All 11 Global Industry Classification Standard (GICS) sectors represented in the 1,000 companies monitored.	The Corporate Net Zero Assessment Tool monitors 1,000 of the world's largest companies in the heaviest-emitting sectors for net zero commitments. The tool projects the emission reductions necessary for these companies to achieve their targets and scores the ambition and legitimacy of their targets based on several quantitative and qualitative criteria.	Bloomberg New Energy Finance. Corporate net zero assessment tool.
All 11 GICS sectors are represented in the companies monitored.	The Science based targets data tool allows clients to track and visualise the ambition levels of companies that have joined the Science Based Targets initiative (SBTi) to establish an emissions-reduction target in line with the Paris Agreement. For those companies that have set and validated a science-based target, the tool also projects the emissions reductions necessary for each company to reach their goals.	Bloomberg New Energy Finance. Science-based targets data tool.
Finalised: Apparel and footwear, Cement, Financial institutions, Forest, Land and Agriculture, Information and Communication Technology (ICT), Maritime, Power. **In development:** Aviation, Buildings, Chemicals, Oil and Gas, steel, transport. **Scoping phase:** Aluminium.	SBTI wants all companies across all sectors to set science-based targets. For some sectors/industries, separate sector-specific methodologies, frameworks and requirements have been developed. In addition, they have published tailored guidance documents for some other sectors to help you through the target-setting process.	Science Based Targets Initiative. The SBTi is a partnership between CDP, the United Nations Global Compact, World Resources Institute (WRI) and the Worldwide Fund for Nature (WWF).
Basic Chemicals, Cement, and Steel.	To support transition, CBI will be expanding its certification scheme used for green bonds, to enable whole entities that are not currently green, but who need to change, to access finance. Sector-specific criteria for the mentioned sectors are now available.	Climate Bonds Initiative.
Airlines, Aluminium, Autos, Cement, Chemicals, Coal Mining, Consumer Goods, Diversified Mining, Electricity Utilities, Oil & Gas, Oil & Gas Distribution, Other Industrials, Paper, Services, Shipping, Steel. Draft framework for the banking sector was published July 2022.	**The Transition Pathway Initiative Global Climate Transition Centre (TPI Centre) is an independent, authoritative source of research and data on the progress of the financial and corporate world in transitioning to a low-carbon economy. The TPI Centre's analysis considers corporate climate governance and carbon emissions:** • Companies are assessed on Yes/No indicators related to climate governance and are given a Management Quality (MQ) score based on these outcomes. • Companies' emissions reduction targets are also assessed against sector-specific benchmarks, to determine their Carbon Performance (CP) alignment with the goals of the Paris Agreement. Emissions scopes are determined based on the most material emissions in each sector and intensity denominators are similarly sector specific.	Transition Pathway Initiative.
Energy, Utilities, Transport, Steel, Cement.	The NZAOA commissioned the Institute for Sustainable Futures (ISF) to apply the One Earth Climate Model (OECM) to sectors as defined by sector classification schemes commonly used in finance (GICs, BICs, and NACE). The aim was to develop sectoral pathways to net-zero by 2050 with carbon emissions (scope 1-2) and energy intensity and carbon intensity (scope 1-2) milestones in 5-year intervals for agreed high emitting sectors.	UN Convened net-zero asset owner alliance.

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Glossary

Best-in-class: An SRI strategy that involves either positive screening or index-adjusted weighting ("ESG tilting") by comparing the ESG characteristics of a firm to its peers.

Carbon footprint: A measure to assess carbon emissions associated with the investments held within a financial institution's portfolio.

Carbon reduction measures: Strategies and actions undertaken by investors to mitigate the carbon emissions associated with their investment portfolios.

Carbon leakage: Situation where, due to stringent climate policies or reputational reasons, businesses were to transfer carbon-intensive production to other firms outside the corporate group perimeter or to countries with laxer emission policies, which may lead to an increase of emissions. The additional emissions resulting from such actions is considered carbon leakage.

Decarbonization and "paper decarbonization": While decarbonization is a deliberate process of reduction of carbon emissions pursued by an organization (e.g. issuer or investor), "paper decarbonization" may entail a pure nominal (and potentially unintentional) reduction of carbon metrics (e.g. carbon intensity or footprint) due to monetary or financial reasons, which do not lead to real-world carbon emissions reduction.

ESG integration: An SRI strategy that aims to enhance traditional financial (risk) analysis by systematically including ESG criteria in the investment analysis to improve risk-adjusted returns.

Extra-financial objective: A set of sustainability goals, which can be determined either in general (e.g., ESG score) or in specific objectives (e.g. climate, environmental, social, governance).

Fiduciary duty: Obligation of an investment manager to act in the fiduciary's best interest, according to a pre-agreed set of investment objectives.

Financial objective: A set of goals set for the investor's portfolio in terms of return, risk, and liquidity, which can be determined either in absolute terms or relative to a benchmark.

GHG emissions: Gases released into the Earth's atmosphere that contribute to the greenhouse effect and global warming. The primary greenhouse gases include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases.

Green bonds: Bonds for which the proceeds should be used exclusively for (predefined) green projects.

Impact investing: An SRI strategy that aims to achieve a quantifiable positive impact alongside financial returns**.**

Investment approach: A set of decision-making criteria, modelling, and investment options to implement investment strategy.

Investment strategy: A set of principles and criteria based on risk tolerance, time horizon, and investment objectives, designed to guide investor's decision to achieve investment goals.

Labelled bonds: Bonds that have specific environmental, social, or governance (ESG) or sustainability purposes. The collected proceeds are used to funding projects or expenditures with ESG benefits or facilitating improvements to an issuer's sustainability targets.

Metrics: Indicators summarizing the evaluation of an issuer's sustainability performance, exposure, and management ability with regard to sustainability risks/opportunities.

Negative screening: A SRI strategy that systematically excludes companies, sectors, or countries from the investment universe.

Net zero strategy: A SRI strategy that aims to align investment portfolios with the goal of achieving net zero greenhouse gas emissions.

Own funds: Any portfolio of a central bank that is not related to a formally mandated (policy) goal, but that is held, for example, to make up for operating expenses or for gathering market intelligence.

Pension funds: Portfolios managed by central banks that serve as long-term savings accounts for retirement and have a longer investment horizon.

Policy portfolios: Any portfolio which has been formally mandated to the central bank, e.g., for monetary policy purposes, foreign exchange interventions, etc.

SRI: Sustainable and Responsible Investment – used throughout the guide as an umbrella term under which multiple strategies and investment practices can be placed that explicitly take climate or broader ESG criteria into account.

Scope 1 greenhouse gas emissions: Direct emissions of greenhouse gases that occur from sources that are owned or controlled by the reporting corporate entity.

Scope 2 greenhouse gas emissions: Indirect emissions of greenhouse gases associated with the consumption of purchased or acquired electricity, steam, heating, and cooling by a firm.

Scope 3 greenhouse gas emissions: Indirect emissions that occur along the value chain of a firm, including both upstream and downstream activities that are outside the corporate direct operational control.

Sustainability risks: Negative financial impacts stemming from a diversity of sustainability factors, e.g. climate-related, environmental, social and governance issues regarding the investee behaviour. These risks can entail different materiality of impacts on asset risk/return profile and can be measured through several data types.

Stewardship: Range of activities undertaken by shareholders to monitor, engage, and intervene on matters that may affect the long-term value of investee companies.

Strategic asset allocation: A portfolio strategy whereby the investor sets target allocations for various asset classes.

Sustainability-linked bonds (SLBs): Bonds where the financial terms, including the coupon rate or principal amount, are linked to the issuer's achievement of predefined sustainability targets or performance metrics.

Sustainable bonds: Bonds with proceeds earmarked for financing projects or activities that have positive environmental or social impacts.

Taxonomy: A set of criteria established as a basis for an evaluation of whether and to what extent a financial asset will support given sustainability goals.

Third-party assets: Assets that a central bank manages on behalf of a third party.

Tilting: A strategy where an investor adjusts the weightings of certain assets within their portfolio relative to a standard benchmark or index, with the aim to enhance returns, manage risk, or realise sustainability objectives.

Total carbon emissions: The sum of greenhouse gas emissions associated with the investments held within a financial institution's portfolio.

Voting and engagement: A SRI strategy that involves exercising ownership rights and "voice" to change a company's behavior with regards to ESG issues, such as the violation of international standards and norms.

Labelled bonds: Bonds with specific characteristics or purposes explicitly "labelled" at the time of issuance. These bonds often finance projects or initiatives that align with certain ESG criteria. Examples of labelled bonds include green bonds, social bonds, sustainability bonds.

Acronyms

BCBS	Basel Committee on Banking Supervision
CDP	Carbon Disclosure Project
CF	Carbon Footprint
CI	Total Carbon Emissions
COP	United Nations Climate Change Conference
CTB	EU Climate Transition Benchmark
ESG	Environmental, social and governance
FSB	Financial Stability Board
GCEL	Global Coal Exit List
GFANZ	Glasgow Financial Alliance for Net Zero
GHG	Greenhouse Gas
IAMs	Integrated Assessment Models
ICMA	International Capital Market Association
IEA	International Energy Agency
IFC	International Finance Corporation
IIGCC	Institutional Investors Group on Climate Change
IRENA	the International Renewable Energy Agency
ISSB	International Sustainability Standards Board
ITR	Implied Temperature Rise
IUCN	International Union for Conservation of Nature
KPI	Key Performance Indicator
MAS	Monetary Authority of Singapore
NGFS	Network for Greening the Financial System
NZAOA	UN-convened Net Zero Asset Owner Alliance
PAB	EU Paris-Aligned Benchmark
PAII	Paris Aligned Investor Initiative
PCAF	Partnership for Carbon Accounting Financials
SBTi	Science Based Targets Initiative
SDGs	Sustainable Development Goals
SEEA EA	System of Environmental Economic Accounting Ecosystem Accounting
SRI	Sustainable and Responsible Investment
SSA	Sub-)sovereigns, Supranationals, and Agencies
TCE	Total Carbon Emissions
TCFD	Task Force on Climate-Related Financial Disclosures
TPI	Transition Pathway Initiative
TPT	UK Transition Plan Taskforce

UNEP FI	United Nations Environment Programme Finance Initiative
UN PRI	United Nations Principles for Responsible Investment
UN GC	United Nations Global Compact
V&E	Voting and Engagement
WACI	Weighted Average Carbon Intensity
WWF	Worldwide Fund for Nature


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