DEUTSCHE BUNDESBANK
EUROSYSTEM

CLIMATE-RELATED DISCLOSURES BY THE DEUTSCHE BUNDESBANK 2024

Part of the Eurosystem-wide climate-related disclosures on the non-monetary policy portfolios (NMPPs)

CONTENT

FOREWORD

Climate change affects society as a whole. The Bundesbank is aware of its responsibility and takes the consequences of climate change and climate policy into account in its work. This is because the associated risks to price stability and financial stability directly affect the Bundesbank's mandate.

Our own balance sheet may also be exposed to climate risks. Regular analysis and disclosure of these risks is an important step towards better protecting our balance sheet from them. At the same time, we are leading by example with our third climate-related disclosures, thereby reaffirming our call for greater transparency in relation to climate-related risks in the financial system.

Climate change is a global challenge that requires coordinated action. The Bundesbank is therefore working closely with central banks and supervisory authorities in Europe and worldwide. Our climate-related disclosures are based on a common Eurosystem framework. Moreover, the Bundesbank is involved in the work of the Network for Greening the Financial System (NGFS) on climate-related disclosures. By ensuring greater transparency, we support the development of a resilient and sustainable financial system.

I would like to thank all at the Bundesbank who have helped draw up this report. Their commitment and expertise are key to our efforts to combat global climate change.

Dr Sabine Mauderer
Member of the Executive Board of the Deutsche Bundesbank

LIST OF ABBREVIATIONS

Abbreviation	Long form
AI	Artificial intelligence
BBankG	Gesetz über die Deutsche Bundesbank (Act concerning the Deutsche Bundesbank)
BIS	Bank for International Settlements
CO_2e	CO_2 equivalents
COO	Chief Operating Officer
COP	Conference of the Parties; also UN Climate Change Conference
CTB	EU climate transition benchmark
ECB	European Central Bank
ESCB	European System of Central Banks
ESG	Environmental, social and governance
ESRB	European Systemic Risk Board
EU	European Union
FSB	Financial Stability Board
GDP	Gross domestic product
GHG	Greenhouse gas emissions
GSFCG	Green and Sustainable Finance Cluster Germany
IEA	International Energy Agency
ILO	International Labour Organization
IMF	International Monetary Fund
ISS ESG	Institutional Shareholder Services ESG
LAGFin	Lenkungsausschuss Green Finance (Green Finance Steering Committee)
LULUCF	Land use, land-use change, and forestry
NGFS	Network of Central Banks and Supervisors for Greening the Financial System
OECD	Organisation for Economic Co-operation and Development

Abkürzung	Langform
PAB	EU Paris-aligned benchmark
PCAF	Partnership for Carbon Accounting Financials
PPP	Purchasing power parity
SFB	Sustainable Finance Advisory Council
SFWG	Sustainable Finance Working Group
TCFD	Task Force on Climate-related Financial Disclosures
tCO_2e	Tonne of CO_2 equivalents
TJ	Terajoules
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UN SDG	United Nations Sustainable Development Goals
WACI	Weighted average carbon intensity
WRI	World Resources Institute

SUMMARY

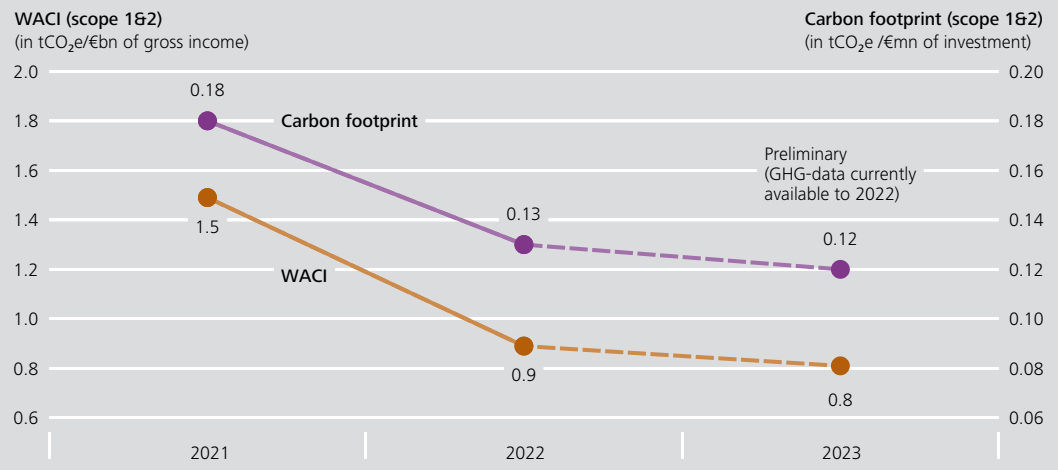
Climate change and climate policy have far-reaching implications for the economic and financial system: they affect the outlook for price stability through their impact on macroeconomic indicators such as inflation and growth, the stability of the financial system and the transmission of monetary policy. They consequently also affect the Bundesbank's core tasks. As part of its mandate, the Bundesbank therefore takes into account relevant sustainability and, in particular, climate aspects. In addition, it advocates for a more sustainable economic and financial system in its work in national and international bodies. Moreover, the Bundesbank implements sustainable investment strategies in its role as fiscal agent for Germany's central and state governments as well as in its own non-monetary policy financial investments (proprietary euro-denominated portfolio, called euro portfolio, and reserve assets). Climate change and climate policy may result in financial risks to the Bundesbank's balance sheet. The Bundesbank therefore continuously analyses to what extent these physical and transitional climate risks affect the value of balance sheet assets and how they can be protected.

For the third year in a row, the Bundesbank is disclosing climate-related financial information on its non-monetary policy financial investments. In this, it is guided by a common disclosure framework among the Eurosystem's central banks. This framework is based on the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) and the Partnership for Carbon Accounting Financials (PCAF). Disclosure includes greenhouse gas (GHG) and other climate-related metrics used as risk indicators or to measure portfolios' climate impact. This year's report builds on past reports and expands its analysis to include physical climate risks for government bonds held and a hypothetical analysis of the climate impact of the Bundesbank's gold holdings.

Regarding the **euro portfolio,** the GHG metrics continued to decline in 2023. This applies to the weighted average carbon intensity (WACI), which reflects the portfolio's GHG intensity, and to the carbon footprint, which sets GHG emissions financed by the portfolio in relation to the portfolio's volume (see Figure 1), amongst other indicators. This is due, first and foremost, to a significant decline in scope 2 emissions, which are primarily created in the generation of purchased electricity. However, these GHG metrics only include direct (scope 1) and scope 2 emissions by banks whose covered bonds are held in the euro

portfolio. The insufficient data on GHG emissions financed by banks (part of scope 3) means that the available metrics are only partially meaningful.

Euro-Portfolio: WACI and carbon footprint Figure 1



Sources: ISS ESG, Bundesbank data and calculations.
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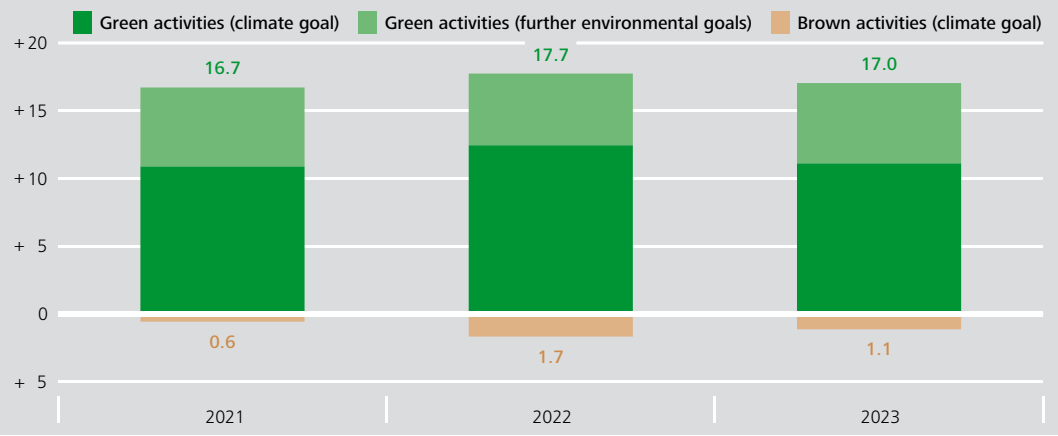
The Bundesbank's **reserve assets** comprise gold holdings, receivables from the International Monetary Fund (IMF) and foreign currency reserves. The latter include investments in national and supranational promotional and development banks as well as in sovereigns.

There is insufficient GHG information for the **asset class of promotional and development banks,** which is why this report does not disclose any such metrics. At 17%, the share of "green" (beneficial to the environment) business activities in the business volume of promotional and development banks remains high. These are primarily attributable to the financing of renewable energy, energy efficiency measures and public transport infrastructure. By contrast, the "brown" (harmful to the environment) share of business activities financed is on the decline and at a low level of 1.1% (see Figure 2).

Promotional and development banks (reserve assets): green and brown shares

Figure 2

Green/brown shares of business activities in %



Sources: ISS ESG, Bundesbank data and calculations.
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The WACI of **investments in sovereigns** has been declining continuously over the period under review since 2015. This is due, amongst other things, to the reduced emissions produced by the energy industries and transport sectors relative to the size of the economy. However, around half of the WACI declines prove to be driven by inflation. For the first time, indicators on states' physical climate risks are also listed as part of the Bundesbank's climate-related disclosures. These show that drought and heat stress risks, in particular, affect large parts of the population, gross domestic product (GDP) and states' agricultural land.

Gold holdings are an important component of central banks' reserve assets, including the Bundesbank's reserve assets. This report presents for the first time an analysis of the climate impact of gold holdings. This analysis is purely hypothetical, as there is no data basis for tracing the actual sources from which the Bundesbank's gold holdings were produced, nor are their GHG intensities known. This hypothetical analysis therefore calculates GHG emissions arising in connection with gold production in the present day. Based on the range of relevant study results, the absolute GHG emissions of a quantity of gold corresponding to the Bundesbank's gold holdings (3,353 tonnes) result in an interval of 52.8 million to 90.8 million tonnes of CO_2 equivalents (CO_2e). Relative to the market value of the gold holdings, the carbon footprint would amount to 262 to 451 tonnes of CO_2e/€mn of investment. However, it should be noted that the metrics cannot be compared to the ongoing annual emissions as a result of securities investments in corporations or governments, but, in fact, reflect one-off GHG emissions related to the production of gold. Based on the average holding period of the Bundesbank's gold (currently around 61 years), the carbon footprint would amount to around 4 to 7 tCO_2e/€mn of investment.

Given such a long and continued use, the Bundesbank's gold holdings provide a more GHG-efficient store of value than conventional securities investments.

Going forward, the Bundesbank will continue to actively promote transparent climate-related disclosures and take account of the consequences of climate change and climate policy in the management of its non-monetary policy financial investments. In this context, it is the Bundesbank's endeavour to address climate-related financial risks and to incorporate the objectives of the Paris Climate Agreement in its mandate.

1 INTRODUCTION

The consequences of climate change and climate policy are seen as challenges not only in environmental protection and politics, but are also receiving increasing attention from central banks around the world. The effects of climate change and the associated economic transformation are impacting the economy and are sources of financial risk. They influence the outlook for price stability through their impact on macroeconomic indicators such as inflation and growth, the soundness of the financial system and the transmission of monetary policy. In addition, climate change and the transformation of the economy have an effect on the value and risk profile of the assets held on the Bundesbank's balance sheet. The effects of climate change thus have implications for the Bundesbank's mandate.

The Eurosystem has therefore committed itself, as one of many measures, to improve climate-related transparency with regard to the non-monetary policy portfolios managed independently by the Eurosystem's central banks. This is reflected in the Eurosystem's common stance for promoting climate change-related sustainable investment. Metrics on the Bundesbank's monetary policy portfolios or monetary policy balance sheet items are not part of the disclosure framework and are reported by the European Central Bank (ECB) on behalf of the Eurosystem as a whole.

Transparency plays a crucial role in the green transformation of the economy. Investors and market participants need clear and reliable information on climate risks and opportunities in order to make informed decisions. Promoting transparency is therefore an important matter for Eurosystem central banks in their efforts to promote sustainable development of the financial system.

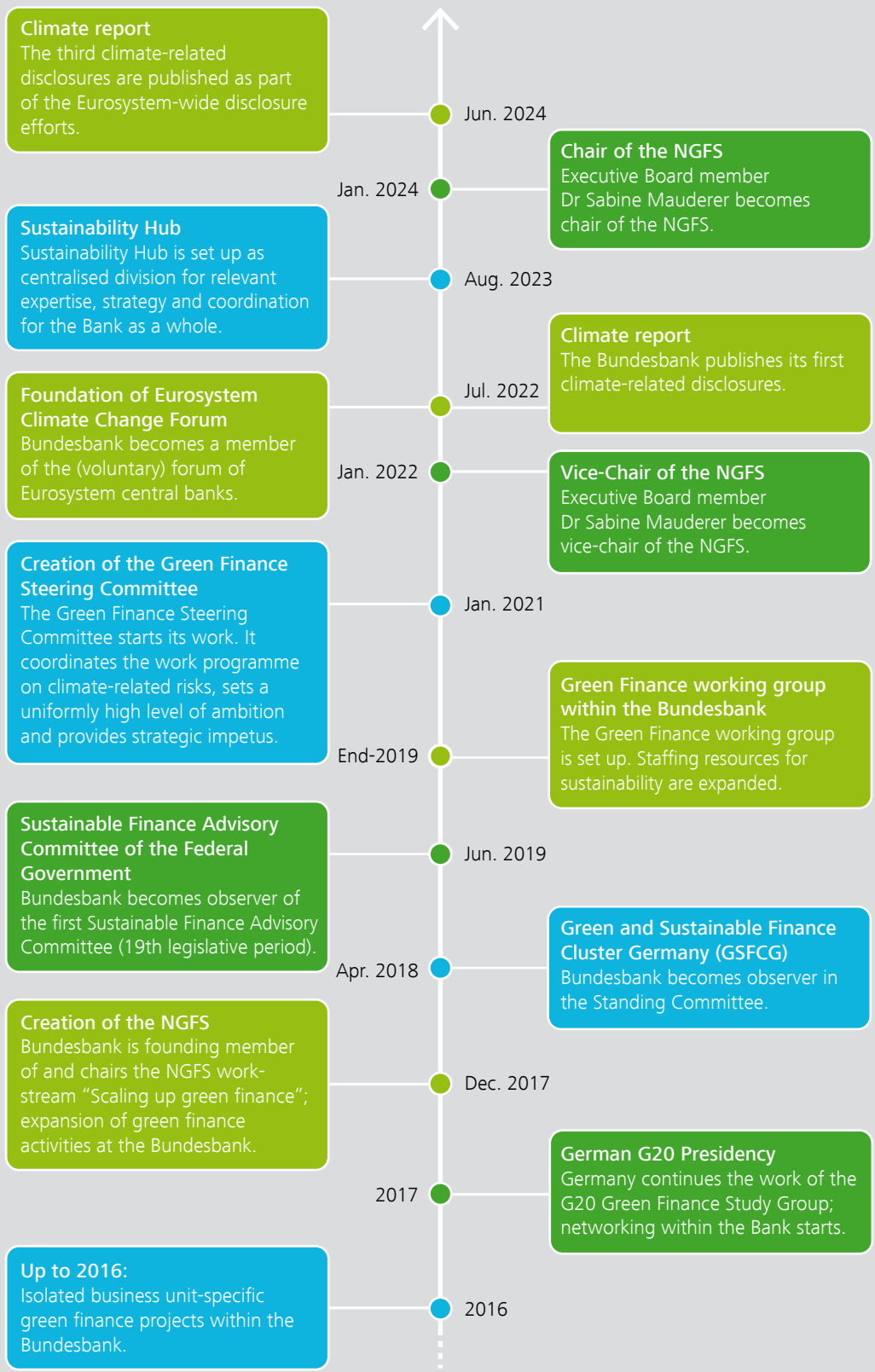
These third climate-related disclosures mark the latest milestone on the Bundesbank's "sustainability journey". It is one of many steps that the Bundesbank has already taken to promote a sustainable economic and financial system. Figure 3 illustrates the key milestones of this development. The report is the result of continuous efforts to refine and improve climate-related disclosure. By promoting market transparency and encouraging public discourse, the Bundesbank can identify its own climate-related risks and simultaneously act as a catalyst for a sustainable financial system.

The report is guided by the four pillars of the Task Force on Climate-related Financial Disclosures (TCFD): governance, strategy, risk management, and metrics and targets. The report includes both climate-related financial risks and detailed information on the GHG footprint of non-monetary policy portfolios. The Bundesbank also reports for the first time on the GHG footprint of its gold holdings and considers physical climate risks for the government bonds held in the reserve assets. The following chapters detail the various aspects of the Bundesbank's efforts with regard to climate-related financial risks.

At the Bundesbank, the subject of sustainability is not limited to financial risks and portfolio management. Aspects relating to operational ecology are also important. For example, the Bundesbank constantly strives to reduce greenhouse gas emissions and energy consumption in its operations.

The Bundesbank's sustainability journey – important milestones

Figure 3



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2 GOVERNANCE

In August 2023, the Bundesbank set up a **centralised division for relevant expertise, strategy and coordination** – the Sustainability Hub. The idea behind this is for Bank-wide work on sustainability and thus also on the impact of climate change and climate policy to be coordinated and steered more effectively, both internally and externally. This new division is responsible for sustainability throughout the Bank and is directly assigned to Executive Board member Dr Sabine Mauderer. As a coordinating and advisory unit, the division is the central point of contact for any sustainability issues across the Bank; it is responsible for efficient coordination and consultation within the Bank as a whole and advises the Executive Board on strategic sustainability issues. The Sustainability Hub is the main contact for the general public and external stakeholders, and represents the Bank in cross-sectional committees together with experts from the relevant business units (see Section 3.1). As a strategy unit, it plays a part in setting out the agenda for projects and analytical work in consultation with the business units and, through its own specialist work, acts as an incubator for the Bank as a whole. Through all of the above, the Bundesbank is further strengthening its sustainability profile and giving due attention to this highly important issue within its governance framework as well.

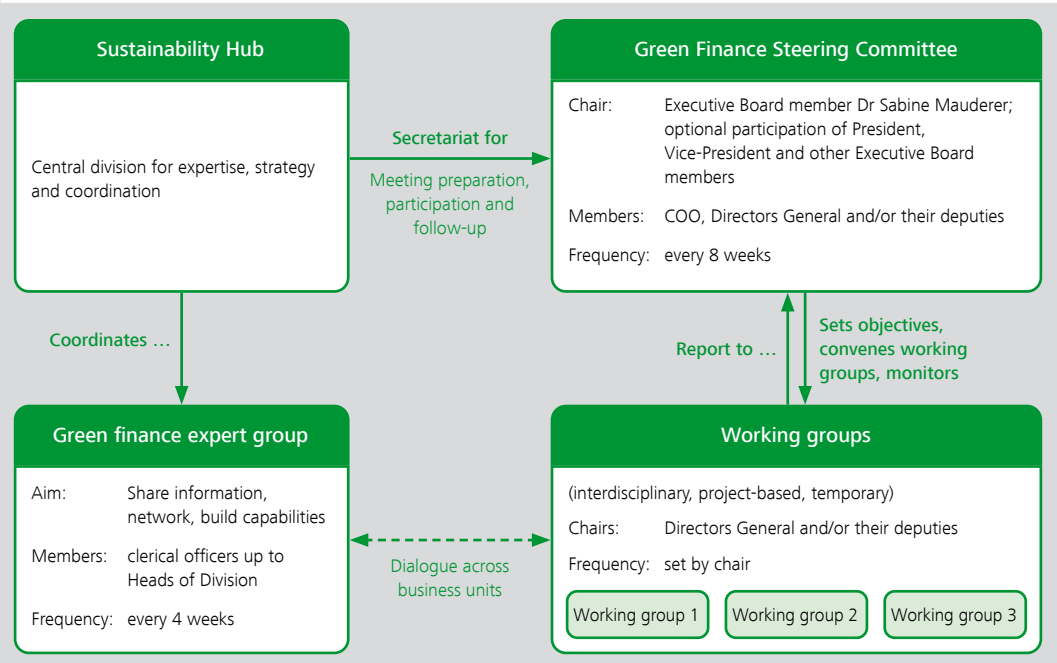
This move comes after the creation of the **Green Finance Steering Committee** back in 2021 to ensure Bank-wide coordination of the work programme on climate-related financial risks and on issues surrounding the financing of the transition, set a uniformly high level of ambition across the Bank as a whole and provide strategic impetus. Chaired by Executive Board member Dr Sabine Mauderer, this committee generally convenes every eight weeks. The Bank's President and other Executive Board members are regular participants in these meetings as well. Meetings are also attended by the Chief Operating Officer (COO) and management-level staff of numerous business units.[1] The Sustainability Hub acts as the secretariat for the committee and sets the agenda. The committee can use working groups made up of staff members from different business units to handle specific sustainability-related projects. Usually, one or two business units take on lead responsibility for the relevant working groups. The working group leads provide regular reports during committee meetings to the participating members of the Executive Board, thus ensuring continuous project monitoring.

1 Banking and Financial Supervision, Financial Stability, Research, Communications, Markets, Legal Services, Risk Control, Data and Statistics, Economics and Sustainability.

The Green Finance Steering Committee ensures that the Executive Board and the relevant Bundesbank business units build internal networks and are informed about the Bank's work. At the same time, Executive Board members have the ability to steer analyses and projects within the various units in a targeted way.

The Green Finance Steering Committee is flanked by a **Green Finance Expert Group,** which is a forum for regular expert-level interaction and dialogue across the Bank. This expert group sets out to promote broad information-sharing on climate-related work within and outside the Bundesbank as well as interdisciplinary networking, and aims to prevent any duplication of work. Additionally, presentations by both internal and external specialists provide impetus and encourage the building of new capabilities. Figure 4 gives a simplified overview of the organisational structure of the Bundesbank's green finance activities.

Green Finance Steering Committee – governance Figure 4



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Work in nearly all areas of the Bundesbank touches on sustainability issues and, in particular, the implications of climate change and climate policy for the financial system. The Bundesbank's research programme, for instance, identifies climate change as one of several cross-cutting issues. The impact of climate change and climate policy on macroeconomic factors such as inflation and growth as well as the transformation of financial markets through sustainable financial products and investor preferences are focal points

in the Bank's theoretical and empirical studies. Financial Research is keeping tabs on developments in new markets for sustainable financial products. In Banking Supervision, the Bundesbank is committed to ensuring that institutions integrate climate risks into their risk management, business and risk strategy, corporate governance and business organisation on the basis of specific regulatory requirements. At the same time, a framework needs to be established for the disclosure of information on climate risks and to strengthen market transparency in the financial market. The Directorate General Financial Stability analyses the systemic impact of climate-related financial risks on the financial system and is developing a policy framework for the possible use of macroprudential instruments. A key requirement for all of this work and analysis is high-quality, granular climate and sustainability data. The box below entitled "Data: a foundation of sustainable action" describes how the Directorate General Data and Statistics is contributing to the work of the Bundesbank and the Eurosystem in this regard.

Data: a foundation of sustainable action

The pool of data relating to sustainable finance is characterised by a shortage of high-quality microdata (i.e. firm-level data), limited data access, a lack of standardisation and data gaps. At the same time, granular climate and sustainability information are an essential tool for central banks to, for instance, analyse the impact of climate change on financial institutions' risks and economic developments. Accordingly, through various initiatives, the Bundesbank has been continuously pushing towards improvements in the pool of data over the short, medium and long term.

In one of these, the Bundesbank set up the Sustainable Finance Data Hub in 2020 as part of the Directorate General Data and Statistics. Its primary task is to make available internally sustainability-related data that is of lasting cross-departmental interest. User requirements are regularly surveyed and the data offering expanded accordingly. The unit initiates and participates in innovation projects aimed at improving data coverage and quality. In addition, it actively participates in the national and international discourse on closing data gaps[2] and publishes the Green finance dashboard. This provides a concise overview of developments in this area in both Germany and the EU-27.

Sustainability-related data at the micro level are currently provided almost exclusively by private data providers. Public, structured data sources are scarce. As part of a European procurement process, the Bundesbank negotiated climate data contracts on behalf of the entire Eurosystem with two data providers, thus laying the foundations for European-level reporting of a comparable standard. In order to make the preparation and provision of data shared in the euro area efficient, the Bundesbank has launched an exchange forum, the ESCB Exchange on Climate Data, where experiences and applications relating to the jointly acquired data are discussed.

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2 The Directorate General Data and Statistics is active, for example, in the Network for Greening the Financial System as co-chair of the data network and in the STC Expert Group on Climate Change Statistics in the development of sustainability-related climate indicators at the macro level.

In order to validate and supplement the existing pool of data and to open up new data sources in the medium term, the statistics unit is involved in innovation projects and initiates research collaborations with the aim of identifying and preparing sustainability-related information through the use of new technologies. For example, the Project Gaia – a collaboration between the Deutsche Bundesbank, the BIS Innovation Hub Eurosystem Center, Banco de España and the ECB – uses artificial intelligence to mine information from corporate disclosures.[3]

In addition to collaboration with other central banks, the Deutsche Bundesbank maintains close ties with academia. Two projects are investigating how AI technologies can be used to obtain information. One approach examines the usability of granular, unstructured climate data for central bank applications. The aim is to generate new climate-related data and link them to existing data in order to build up uniform, high-quality databases for central bank analyses. Another project is looking into the extent to which satellite pictures and street view images can be used for data quality control.

The implementation of disclosure and standardisation policies can improve the availability of public data in the medium to long term. A European working group chaired by the Bundesbank and consisting of European central banks and statistical institutions was set up to analyse ways of accessing and using the considerably expanded sustainability reporting requirements of large corporations.[4] In addition, the Bundesbank is partnering the launch of the European single access point for information about entities, planned for 2027, which will facilitate and harmonise public access to sustainability-related information.

The consistent measurement of GHG emissions (carbon contents) at the product, firm and aggregate level was discussed in an international workshop in February 2024 hosted by the Bundesbank in collaboration with the International Monetary Fund, the Irving Fisher Committee of the Bank for International Settlements, Eurostat, Banco Central de Chile and the University of Oxford Blavatnik School of Government. The participants reached a shared understanding that the development of standards for the recording of GHG emissions at company level was necessary in order to achieve comparable and verifiable firm and product level results. These standards must match those of the official statistics in order to achieve consistent micro and macro results.[5] Following the conference, an international

3 Further information can be found on the project page: Project Gaia: Enabling climate risk analysis using generative AI (accessed on 30 April 2024)
4 For example, a brief overview of the new EU Corporate Sustainability Reporting Directive (CSRD) is available at Corporate sustainability reporting - European Commission (europa.eu) (accessed on 3 June 2024)
5 Further information can be found on the conference page: Carbon content measurement for products, organisations and

working group was set up to examine ways in which these objectives can be introduced and established in the real world.

A reliable pool of data is essential for a central bank to fulfil its range of tasks. At the national, European and global levels, work is being carried out to enhance existing statistics, for example within the framework of the G20 Data Gaps Initiative. Many international projects on disclosure and standardisation, as well as on the use of new technologies, hold out the long-term promise of a broad, high-quality, publicly available dataset which, ultimately, should be consistent with the fundamental principles of official statistics. The Bundesbank is working on improving the pool of data in an active, innovative and agile manner.

aggregates: creating a sound basis for decision making (accessed on 12 April 2024).

3 STRATEGY

As a central bank, the Bundesbank faces the challenge of understanding sustainability risks and the economic impact of climate change and responding appropriately. The Bundesbank therefore takes sustainability and climate aspects into account within its mandate and integrates these into its actions. This is reflected, amongst other things, in the integration of climate considerations into its financial investments. The Bank implements sustainable investment strategies both in its proprietary investments and in its role as a fiscal agent for investments by central and state government and other public administrations.

The global dimension of climate change also underlines the need for enhanced cooperation at the national and international level. The Bundesbank advocates for a sustainable economic and financial system and seeks to improve the management of financial sustainability risks through, amongst other things, its analyses and active participation in committees.

With the assumption of the chair of the Network for Greening the Financial System (NGFS) by Bundesbank Executive Board member Dr Sabine Mauderer, the Bundesbank has assumed a leadership role in the global discussion amongst central banks. Active participation in international forums such as the NGFS enables the Bundesbank to help shape the international climate agenda, share best practices, support policy initiatives and, together with other central banks and supervisory authorities, develop solutions for a financial system that is resilient to climate risks.

3.1 Committee work on climate

3.1.1 International bodies

Network for Greening the Financial System (NGFS)

The Bundesbank is a founding member of the NGFS, a global alliance numbering just under 140 central banks and supervisory authorities. The NGFS is pushing to make the financial system more sustainable. Its goal is to analyse the implications of climate change for the financial system and, with a view to tilting global financial flows, to strongly advocate for enabling climate-friendly, low carbon economic growth in a way that supports the achievement of the Paris Climate Agreement targets. Moreover, the NGFS also makes a contribution to the global debate on the impact of climate change on the economy and financial markets and to the further development of joint analyses and insights. Besides facilitating expert-level analysis, the network mainly serves as a platform for sharing best practices for identifying climate-related financial risks and improving the way they are managed. It also explores ways to integrate sustainability aspects into investment decisions, thereby contributing to efforts to achieve best practices that are as international as possible.

The Bundesbank is actively contributing its expertise to the NGFS. Bundesbank Executive Board member Dr Sabine Mauderer assumed the post of Vice-Chair of the NGFS in 2022. At the beginning of 2024, she took over as Chair for the next two years; she is thus a key player in defining the strategic focus of the NGFS. This underlines the Bundesbank's intention, going forward, to make even more of a contribution to the debate on incorporating climate change considerations into the range of tasks performed by central banks and, within its mandate, to take them into account in its own actions.

Last year (2023), the NGFS prepared a large number of publications on various topics. In addition to long-term climate scenarios in great demand beyond the world of central banks, these also include concept notes for developing short-term scenarios and analysing nature-related financial risks, an initial stocktake of frameworks for transition plans in the financial sector and a practice-oriented handbook on blended finance as a climate finance instrument.

In 2024, the NGFS launched its new work programme, which envisages a large number of revisions of existing products and new work by the beginning of 2026. The particular focus will be on further work on transition plans, biodiversity risks and adaptation to climate change. Work on the interaction between climate change and monetary policy and the

consideration of climate criteria in financial investments will also continue. In addition, climate-related disclosures are being continuously enhanced, about which work on a new report is currently being finalised. The methodology of the NGFS's own long-term scenarios is also in the process of being revised. Last but not least, the NGFS was prominently represented at the UN Climate Change Conference in Dubai (COP28) with a series of its own workshops and is also planning to be similarly present at the forthcoming COP29 in Baku.

G20

Within its mandate, the Bundesbank is, along with the Federal Ministry of Finance, a member of the Finance Track of the G20, a group that comprises the 20 largest economies. Amongst other things, the Bundesbank is involved in the *G20 Sustainable Finance Working Group (SFWG)*. The SFWG was mandated by the G20 finance ministers and central bank governors to identify institutional and market barriers to sustainable finance and to develop alternatives for overcoming these obstacles. The SFWG in particular and the G20 in general thus contribute to aligning the international financial system with the goals of the Paris Agreement. For 2024, the SFWG, under the Brazilian G20 Presidency, will focus, amongst other things, on paving the way for transparent and credible transition plans and addressing barriers to the implementation of sustainability disclosure for small and medium-sized enterprises (SMEs).

G7

Within its mandate, the Bundesbank also participates in discussions among the G7 finance ministries and central banks on climate change. A particular Bundesbank focus lies on improving analytical understanding of the short and long-term macroeconomic impacts of climate change and various climate policies. To this end, the Bundesbank is involved in a G7 expert network for the relevant economic modelling.

Eurosystem Climate Change Forum

At the Eurosystem level, the Bundesbank is represented on the Climate Change Forum, which was established in July 2022. This (voluntary) association of national central banks serves as a vehicle for fostering information exchange and knowledge sharing within the Eurosystem and for coordinating topics and projects relating to climate risks and the impact of climate change on central banks' activities. The forum leverages the Eurosystem's expertise to support the work of the national central banks and to jointly advance the Eurosystem's climate agenda. The Bundesbank plays an active role in the discussions and contributes its expertise to the joint work.

Financial Stability Board (FSB)

As a member of various working groups, the Bundesbank participates in the comprehensive roadmap for addressing climate-related financial risks published by the FSB in July 2021. Progress in the work is reported annually. Key areas of work include the analysis of cross-border vulnerabilities and the development of regular monitoring of climate-related financial risks.

Joint European Central Bank (ECB)/European Systemic Risk Board (ESRB) Project team on climate risk

The Bundesbank was represented in the project team, founded in April 2019. This joint ECB/ESRB project team developed a metrics-based surveillance framework for climate-related risks, strengthened the empirical and analytical basis for climate scenario analysis, developed a macroprudential framework for managing climate-related risks and addressed the potential economic and financial implications of nature-related risks. Following the publication of the project team's fourth and final report at the end of 2023, macroprudential climate issues will continue to be discussed in the existing ECB and ESRB bodies.

3.1.2 National bodies

The Bundesbank has been an observer of the Federal Government's Sustainable Finance Committee (SFC) since its establishment in the 19th legislative period in 2019 and has always played a constructive role in the SFC's discussions and negotiations. It has thus helped lay the foundations for Germany's Sustainable Finance Strategy, which was built around the SFC's final report for the 19th legislative term. The SFB will continue in the current 20th legislative term. The Bundesbank continues to be represented as an observer in the SFB and provides advisory services.

Since 2018, the Bundesbank has been an observer of the Standing Committee of the Green and Sustainable Finance Cluster Germany (GSFCG). As the main platform for dialogue and cooperation among private and public market participants on the topic of sustainable finance in Germany, the GSFCG pools resources, facilitates the exchange of views and best practices, produces its own assessments and opinions, offers training courses and organises expert-level dialogue for the German financial centre.

3.2 Eurosystem action plan to incorporate climate change considerations into monetary policy framework

With its strategy decision in July 2021 and its decision in March 2024 to adjust the monetary policy framework, the Governing Council has enabled the Eurosystem, within its mandate, to include climate change considerations in the implementation of monetary policy. Consistent with the secondary monetary policy objective, the aim is to support general economic policy in the European Union, and particularly the transition to a green economy, provided this does not conflict with the primary objective of price stability. Against this background, it is intended that climate-related aspects will be incorporated into structural monetary policy instruments when further designing the operational framework. Previously adopted measures to account for climate change relate mainly to corporate bond purchases, the collateral framework, disclosure requirements for collateral, and risk assessment and management.[6] The Bundesbank contributes actively to the Eurosystem's working structures in order to improve the analytical tools for assessing and forecasting the impact of climate change and green transformation on the macro economy and the management of climate-related risks for the Eurosystem's balance sheet and collateral framework.

3.3 The Bundesbank as fiscal agent

Pursuant to its legal mandate (Section 20 of the Bundesbank Act read in conjunction with Section 19 of the Bundesbank Act), the Bundesbank performs a wide range of tasks as a fiscal agent for central government, state governments and other public administrations. Fiscal agent activities include, in particular, passive portfolio management, trading and settlement as well as independent risk control and performance reporting. Passive or rules-based portfolio management for equities and bonds is provided in accordance with individual client requirements.

In recent years, the promotion of sustainability and climate protection objectives has become an established criterion for client investments. In this context, the Bundesbank provides operational and analytical support in the implementation of the clients' individual sustainability objectives. In addition, the Bundesbank is continuously developing its range of sustainability-related investing services in line with client needs.

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6 An overview of the measures and their design can be found on the ECB's website.

It now takes sustainability criteria into account in almost all of the 16 third-party portfolios under management. In the equity sector, many clients use equity indices that are tailored to their intended sustainability objectives. In this context, the sustainability benchmarks as defined by the EU (the EU Climate Transition Benchmark (CTB) and EU Paris-aligned Benchmark (PAB)) are playing an increasingly important role for clients. Furthermore, clients are increasingly also integrating bonds into their sustainability strategy and taking sustainability criteria into consideration for bonds, including covered bonds.

3.4 Sustainable investment strategy for the euro portfolio

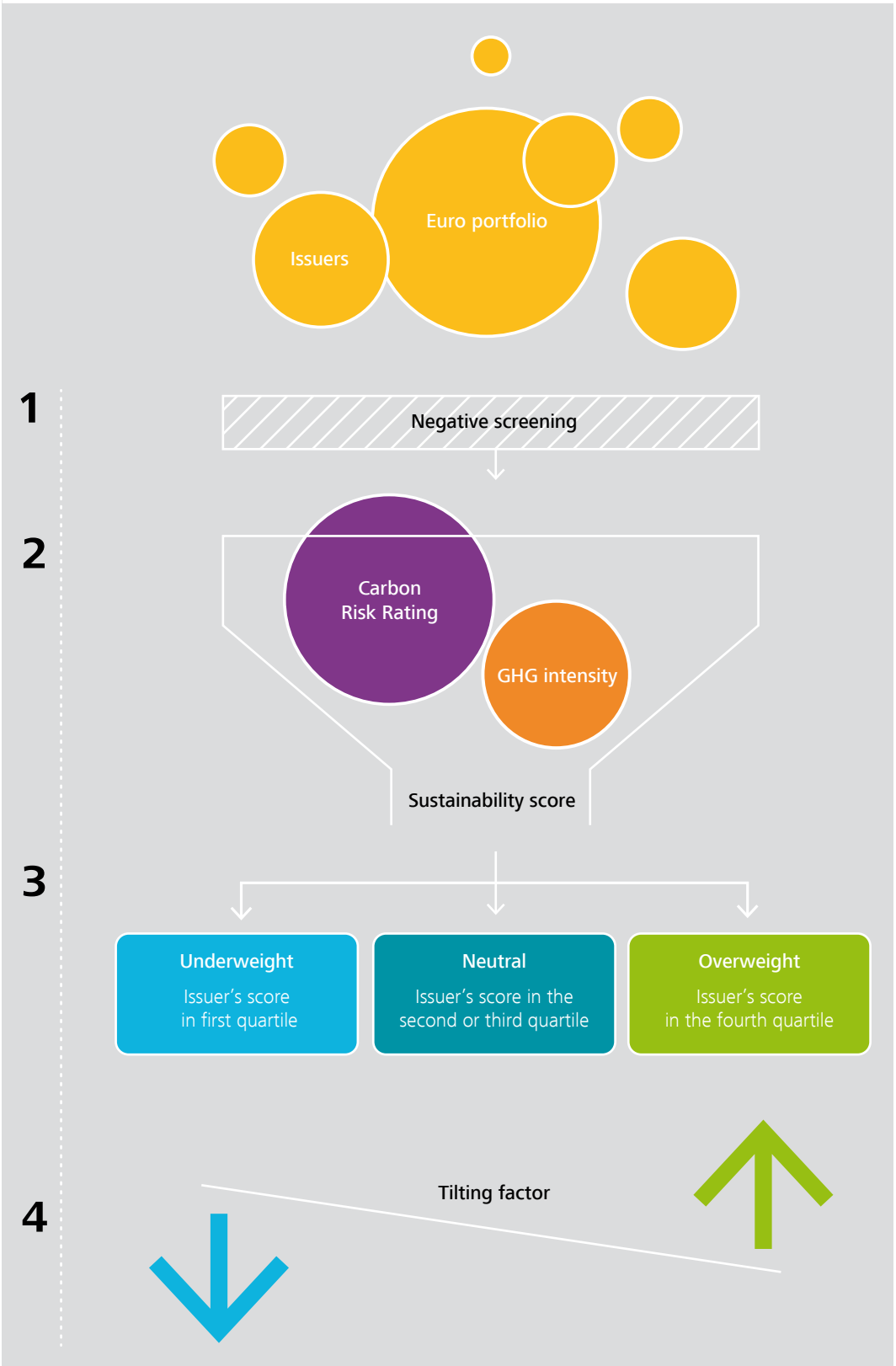
The Bundesbank manages a non-monetary policy euro-denominated securities portfolio (euro portfolio) as an asset-side counterpart to its long-term provisions for civil servant pensions and healthcare assistance, capital and reserves. As a result, the target volume of the euro portfolio is predefined and the volume's share in the Bundesbank's balance sheet can be regarded as low.

Currently, the euro portfolio includes euro-denominated covered bonds from the jurisdictions of Germany, France, Finland, Belgium and the Netherlands. These debt securities are generally held to maturity.

Within the scope of its statutory mandate, the Bundesbank's target criteria include not only earnings, safety and liquidity but also sustainability. The sustainable investment strategy for the euro portfolio consists of four steps and focuses on climate change and the transformation to a net zero economy (see Figure 5).

Sustainable investment strategy for the euro portfolio

Figure 5



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In a first step, issuers are subjected to a negative screening for systematic and serious breaches of globally recognised minimum standards: specifically, the United Nations (UN) Global Compact, the Organisation for Economic Co-operation and Development (OECD) Guidelines for Multinational Enterprises, the International Labour Organization (ILO) core labour standards and international treaties on prohibited weapons. If an issuer breaches these criteria, its securities are excluded from the investable universe. Second, issuer-related indicators are defined in order to calculate a sustainability score consistent with the Bundesbank's understanding of sustainability. The indicators currently being used are the "Carbon Risk Rating" developed by the ESG data provider ISS ESG and issuers' GHG intensity. In a third step, issuers are classified into three groups based on their sustainability score to overweight them, underweight them or declare them neutral. Finally, a "tilting factor" determines the strength of the reweighting in the benchmark portfolio.

The intention is to gradually expand the investment strategy pursued in the euro portfolio and regularly review its suitability. This is also particularly important if the quality of the available data improves to such an extent that bond issuers' GHG emissions can be assessed more comprehensively.

3.5 Sustainable investment strategy for foreign currency reserves as part of reserve assets

The Bundesbank's reserve assets comprise gold holdings, receivables from the IMF and foreign currency reserves. Foreign currency investment is made in US dollars, Japanese yen, Australian dollars, Canadian dollars and Chinese yuan (renminbi). The majority of this constitutes sovereign bonds. Holdings also include bonds issued by sub-sovereigns (e.g. federal states and provinces) and by supranationals and agencies (generally national or supranational promotional and development banks).

In 2023, the Bundesbank implemented a sustainable investment strategy for the foreign currency portion of reserve assets in order to take greater account of climate-related financial risks and – where possible without hampering the fulfilment of its currency policy tasks – to combat climate change.

The strategy focuses on the eligibility of issuers. Since restrictions on sovereign bonds (United States, Japan, Australia, Canada and China) are virtually impossible owing to the overarching currency policy-driven requirements, the Bundesbank has developed suitable approaches for the remaining issuer groups of relevance (sub-sovereigns and promotional and development banks).

For purchasing securities issued by sub-sovereigns, the sub-sovereign has to have a better climate profile than the corresponding sovereign. The climate profile is determined by the total GHG emissions and the volumes of fossil fuels produced in the sub-sovereign region, each relative to the size of its economy. Thus, in foreign currency investment, the Bundesbank refrains from investing in sub-sovereigns with a worse climate profile than the corresponding sovereign. If a sub-sovereign has a significantly worse climate profile than the corresponding sovereign, the Bundesbank would, moreover, consider actively selling the securities holdings in question.

For purchasing bonds issued by promotional and development banks, minimum requirements in terms of a climate-focused sustainability score are defined. Sustainability scoring for issuers is based on three pillars: 1) green and/or brown shares of business activities; 2) ambition, e.g. with regard to GHG reduction targets or the exclusion of fossil energy financing; 3) transparency and/or the quality of climate-related disclosures. The results of these three pillars are weighted and merged to form an overall score, with pillar 1 being the main focus of the overall score. In foreign currency investment, the Bundesbank will therefore not invest, in particular, in promotional and development banks which provide a considerable level of funding to sectors that harm the climate and the environment, such as the fossil fuel sector. In addition, sustainability scoring is in line with the Bundesbank's aim of creating an incentive for issuers to set themselves climate goals and to disclose climate-related information. If an issuer falls significantly short of the sustainability requirements, a sale is considered.

In addition, as for the euro portfolio, an ongoing negative screening for systematic and serious breaches of globally recognised minimum standards is carried out for promotional and development banks.

4 RISK MANAGEMENT

The Bundesbank works to take climate-related risks into account over the entire risk management cycle, i.e. when identifying, analysing, measuring, communicating and managing risks. In organisational terms, this is being implemented using the existing risk management structure: responsibility for the Bundesbank's financial business risks lies with Risk Control, which is segregated from risk-taking market operations units up to and including the Executive Board level.

The risk management perspective naturally focuses primarily on how climate policy and climate change may affect the value of the Bundesbank's balance sheet assets and how the balance sheet can be protected from climate-related financial risks, should the need arise. These risks may be transition risks associated with climate change mitigation measures such as a carbon tax or with changed consumer preferences, such as a shift towards electric vehicles. There are also physical risks stemming from climate change. These include acute risks from extreme weather events such as floods and droughts, and chronic risks such as rising sea levels.

Theoretically, this perspective can be viewed separately from one that focuses on the climate impact of an organisation's own business activities. This impact should, as appropriate, be taken into account when planning and making decisions in order for the organisation to contribute to climate change mitigation within the scope of its mandate. In practice, the two perspectives often overlap. For example, the GHG metrics outlined in the following section are used both as risk indicators and for measuring climate compatibility. The sustainable investment strategies presented in this report for the euro portfolio and foreign currency reserves held as reserve assets also combine both perspectives.

Ultimately, the Bundesbank would risk public disapproval if it did not attend in any noteworthy way to climate considerations in its own business activities, or even ignored them entirely. This could thus cause reputational damage, a matter of great importance for central banks in particular.

The ability to expand risk management in respect of climate-related financial risks hinges on the quality and availability of relevant data and the standardisation of measurement concepts. It is likely that the progress seen here so far is being helped along by regulatory

requirements, e.g. in sustainability reporting, gradually becoming more widespread. To continue enhancing and refining the Bundesbank's methodological concepts, it is beneficial to facilitate in-depth expert dialogue with colleagues working in areas such as banking supervision and financial stability, who also take a risk perspective. This applies within the Bank itself and, in particular, in partnership with other central banks, financial institutions and the academic community. In areas touching upon the analysis of climate-related risks in monetary policy operations and portfolios as well as risk management options to protect the balance sheet, cooperation with other Eurosystem central banks in the relevant forums is essential.

5 METRICS AND TARGETS

By reporting climate and sustainability metrics, the Bundesbank is participating in the measures taken by Eurosystem central banks to increase transparency about climate risks and climate impacts of their own investments. Since 2023, reporting by Eurosystem central banks has been based on a common disclosure framework. In line with that framework, this report does not contain any metrics on the Bundesbank's monetary policy portfolios or monetary policy-related balance sheet positions.

The GHG metrics are the weighted average carbon intensity (WACI), total carbon emissions and the carbon footprint. The relevant methodologies are detailed in the Annex. These are aligned with the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) and the Partnership for Carbon Accounting Financials (PCAF).

5.1 Euro portfolio

As at the reporting date of 31 December 2023, the euro portfolio consisted exclusively of covered bonds – as was the case on the reporting dates of previous disclosures. These are bonds issued by banks, which are mainly backed by real estate mortgages. The following metrics relate to the issuers of the bonds. The decisive factor is thus the sustainability and environmental performance of the issuing banks (in relation to their overall business activities).

5.1.1 GHG metrics

Overview of GHG metrics for the euro portfolio Table 1

		Portfolio as at:		
		31.12.2021	31.12.2022	31.12.2023
Portfolio holdings (by nominal value)		**€10.0 billion**	**€8.9 billion**	**€7.3 billion**
WACI (in tCO_2e/€mn of gross income)	**Scope 1 & 2**	**1.49** *(86.4%)*	**0.89** *(92.3%)*	**0.81** *(94.1%)*
Total carbon emissions (in tCO_2e)	**Scope 1 & 2**	**1,445.4** *(80.0%)*	**1,037.0** (87.0%)	**762.0** *(90.2%)*
Carbon footprint (in tCO_2e/€mn of investment)	**Scope 1 & 2**	**0.18** *(80.0%)*	**0.13** *(87.0%)*	**0.12** *(90.2%)*

Coverage (by portfolio volume) in italics and parentheses.
Sources: ISS ESG, Bundesbank data and calculations.

As at 31 December 2023, the WACI (scope 1 & 2) of the euro portfolio was 0.81 tonnes of CO_2e per million euro of gross income (see Table 1). Due to the retroactive revision of the GHG data for portfolio holdings as at end-2022, a significant reduction in the WACI since the end of 2021 is now evident. The main reason for this is a sharp decline in scope 2 emissions (see Figure 6). In particular, this is likely to be because more electricity was obtained from renewable sources.

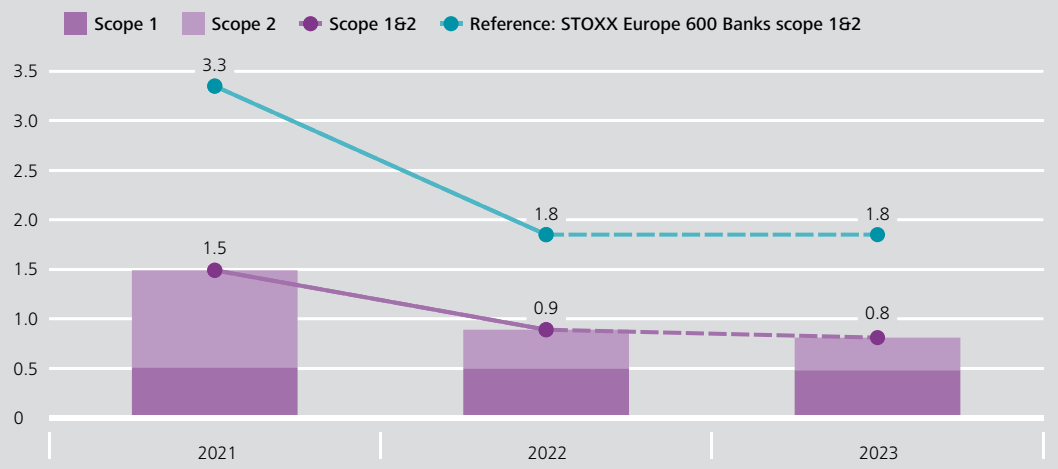
The euro portfolio is roughly half as GHG-intensive compared with the average of the 39 largest European banks by market capitalisation according to the STOXX Europe 600 Banks stock index.[7] For the STOXX Europe 600 Banks index, too, the decline in GHG intensity is largely attributable to scope 2 emissions.

7 Bundesbank calculation based on the composition of the STOXX Europe 600 Banks index as at 28 March 2024 and ESG data from ISS ESG.

Euro portfolio: evolution of WACI (scope 1&2)

Figure 6

tCO_2e/€bn of gross income



Sources: ISS ESG, Bundesbank data and calculations.
Deutsche Bundesbank

Total carbon emissions (scope 1 & 2) as at 31 December 2023 amounted to 762.0 tonnes of CO_2e. GHG emissions financed by the euro portfolio thus continue to decline significantly. This effect is due in part to the reduction in portfolio holdings since the end of 2021 (from €10.0 billion in 2021 to €7.3 billion in 2023). However, the **carbon footprint** (scope 1 & 2), which expresses total carbon emissions in relation to portfolio volume, also shows a decrease (from 0.18 to 0.12 tonnes of CO_2e/€mn of investment from 2021 to 2023).

The aforementioned GHG metrics represent only a small part of total GHG emissions connected with the euro portfolio, however. This is because neither scope 1 nor scope 2 emissions include, inter alia, GHG emissions associated with the financing activities of the issuing banks. The latter fall under scope 3 emissions. Despite continuous improvements, the data available on this still do not provide sufficient coverage of the euro portfolio (see Box 1). The informative value of the GHG metrics is therefore significantly limited with regard to the euro portfolio.

Box 1:

Scope 3 emissions of banks: data situation and findings regarding the euro portfolio

Scope 3 emissions include the indirect GHG emissions of a corporation that are generated along the value chain. However, when looking at enterprises from different sectors, upstream or downstream processes may differ significantly and corporations might not have the same degree of control over the emissions from those processes.

The accounting standards of the GHG Protocol incorporate this heterogeneity by differentiating between 15 categories of scope 3 emissions. These facilitate meaningful comparisons of scope 3 subsets. Many banks are already disclosing some of their scope 3 emissions attributable, for example, to purchased goods and services (category 1), business travel (category 6) or employee commuting (category 7). However, the largest volumes stem from financed GHG emissions (category 15: investments). To date, only a few banks have collected and disclosed data on this, though. The availability of these data is therefore much more limited than that of data on scope 3 emissions of corporations operating in the real economy.

Scope 3 data disclosed by banks which include financed GHG emissions are only available for around 24% of the euro portfolio holdings as at 31 December 2023.[8] Nearly all banks disclosing such data put their financed scope 3 emissions (category 15) at more than 99% of their total scope 1, 2 and 3 emissions. The rest of their emissions predominantly fall under other scope 3 categories. If all scope 3 categories are included, they exceed scope 1 & 2 emissions by factors in the high three-digit to mid four-digit range.

Nevertheless, actual financed emissions are likely to remain significantly underrepresented. So far, scope 3 data on financed GHG emissions have often been confined to assets for which GHG-related methodologies and data are comparatively well established and accessible (e.g. shares, real estate, loans to large enterprises). While it is evident that many banks are gradually expanding their disclosures of financed emissions to include other assets, the comparability of scope 3 data is very limited both across banks and with data reported in previous years.

Despite the significant progress made in the availability of scope 3 data, it is not possible to draw robust conclusions as yet.

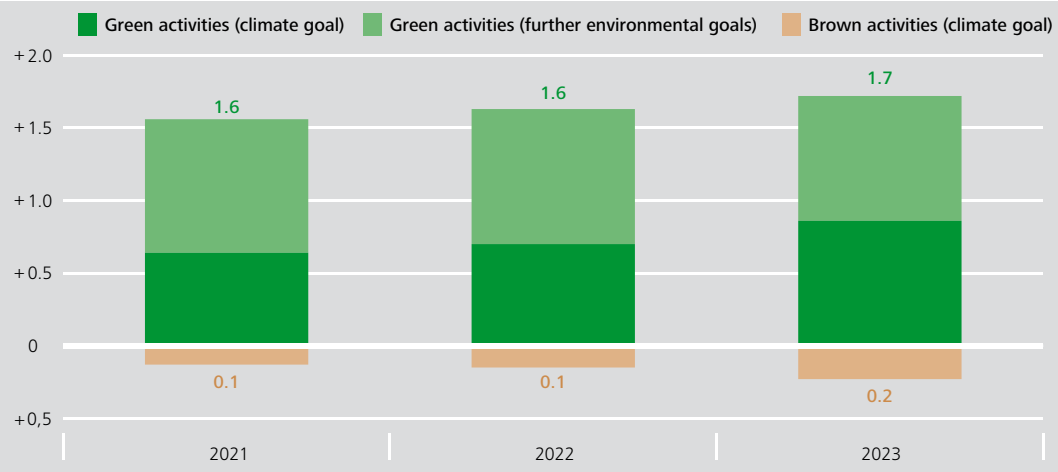
8 This is based on data from ISS ESG.

5.1.2 Green and brown shares of business activities

The green and brown shares of a portfolio are dependent on the business activities of corporations financed by the portfolio. The metrics consider green and brown business activities as a share of a corporation's revenue. This is based on a classification system created by ISS ESG, which classes business activities as beneficial ("green") or harmful ("brown") to the environment in alignment with the UN Sustainable Development Goals (SDGs). If the funded corporations are banks (as in the case of the euro portfolio), shares of business volume (including lending and investment) rather than revenue shares are taken into account. Based on these shares, a weighted average is calculated for the portfolio along similar lines to the WACI methodology.[9]

Euro portfolio: green and brown shares Figure 7

Green/brown shares of business activities in %



Sources: ISS ESG, Bundesbank data and calculations.
Deutsche Bundesbank

As shown in Figure 7, the euro portfolio has a **green share** of 1.7%. The green share is thus higher than the average green share of the STOXX Europe 600 Banks index (0.7%);[10] half of these green activities are attributable to financing that is primarily assigned to the climate goal based on the SDGs ("Mitigating climate change"). This is predominantly the financing of renewable energies and energy efficiency measures. The other half of the green business activities primarily serve the environmental goal of "Promoting sustainable buildings", but thus are also very much climate-related. This includes financing of real estate certified as sustainable and/or energy-efficient.

9 To avoid multiple counting, the Bundesbank counts business activities that ISS ESG assigns to multiple environmental goals only once for the green or brown share.
10 Bundesbank calculation based on the composition of the STOXX Europe 600 Banks index as at 28 March 2024 and ESG data from ISS ESG.

By contrast, the **brown share** of the euro portfolio stands at 0.2%, which is below the average for STOXX Europe 600 Banks (1.6%). The brown share of STOXX Europe 600 Banks is largely attributable to financing for purchases of vehicles with internal combustion engines. This is of very little relevance for the business activities of banks whose bonds are held in the euro portfolio.

ISS ESG does not count the majority of financing as either beneficial or harmful to the environment. However, the extent to which environmental impact can be accounted for depends on the level of transparency regarding sustainability – and this varies widely, especially among commercial banks. The metrics thus provide an initial indication of banks' climate and environmental sustainability, but their informative value could benefit significantly from greater transparency in the financial markets on matters of sustainability.

5.1.3 International norms and other sustainability aspects

In accordance with the sustainable investment strategy for the euro portfolio, bond issuers are screened for compliance with minimum standards on an ongoing basis. The negative screening for breaches of international norms is grounded in the norm-based assessment of entities by the ESG data provider ISS ESG. As at 31 December 2023, the euro portfolio did not include any bonds issued by entities for which ISS ESG had detected serious proven (e.g. legally) breaches of international standards. Nor did ISS ESG identify any involvement in controversial weapons for any of the entities. The euro portfolio thus meets the minimum standards set out in the sustainable investment strategy.

The sustainable investment strategy for the euro portfolio does not envisage any targeted purchases of green bonds (or comparable forms of bonds). Accordingly, green bonds accounted for only a small share of the portfolio volume as at 31 December 2023, at 0.5%.

5.2 Reserve assets

With regard to the Bundesbank's reserve assets, portfolio holdings are determined by currency policy-driven requirements. The reserve assets comprise gold holdings, receivables from the IMF and foreign currency reserves.

The following GHG and sustainability metrics are based on the foreign currency reserves in the reserve assets. They predominantly consist of sovereign and sub-sovereign assets, the majority of which are US Treasuries. Aside from these, bonds issued by national or supranational promotional and development banks are also held. Assets relating to the Bank for International Settlements (BIS) are not incorporated into the calculation of the metrics.

5.2.1 Investments in promotional and development banks

Reserve assets: holdings of investments in promotional and development banks Table 2

	As at:		
	31.12.2021	31.12.2022	31.12.2023
Total (by nominal value)	**€2.03 billion**	**€2.16 billion**	**€2.07 billion**

The calculation of the following metrics on investments in national or supranational promotional and development banks follows the same methodology as for the euro portfolio.

5.2.1.1 GHG metrics

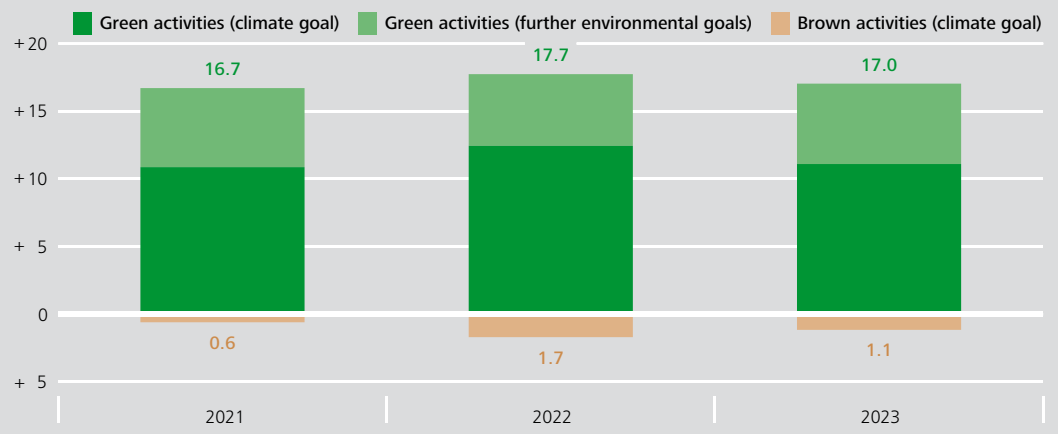
In comparison to commercial banks, promotional and development banks, especially supranational ones, have rarely disclosed their operational GHG emissions (scope 1 & 2) to date. It is therefore not possible to calculate GHG metrics that cover a significant proportion of the investments in promotional and development banks. For this report, therefore, no such metrics are reported. As is the case for the euro portfolio, the data available on banks' scope 3 emissions are also insufficient.

5.2.1.2 Green and brown shares of business activities

Extensive findings are available for the business activities of promotional and development banks, including on their **green and brown shares.**[11] Data availability benefits from promotional and development banks being required by their mandates to exercise a high degree of transparency surrounding their financing activities.

Investments in promotional and development banks (reserve assets): green and brown shares Figure 8

Green/brown shares of business activities in %



Sources: ISS ESG, Bundesbank data and calculations.
Deutsche Bundesbank

The **green share** of investments in promotional and development banks as at the reporting date of 31 December 2023 is stable compared with previous years and remains at a sizeable 17.0%. The bulk of it is made up of financing arrangements aimed primarily at achieving the climate goal within the meaning of the SDGs ("mitigating climate change"). In the interests of achieving this goal, promotional and development banks' business activities include, inter alia, the financing of renewable energy, energy efficiency measures and public transport infrastructure.

The remaining green share of business activities is aimed mainly at the environmental goal of conserving water. The financing of water treatment facilities in particular accounts for a substantial share of business volumes at promotional and development banks. Smaller shares of financing activities are classified predominantly to biodiversity and nature-related environmental goals, e.g. financing provided for projects to protect land and water-based ecosystems.

The **brown share** remains at a low level. Having increased in 2022, it was back on the decline in 2023. The bulk of the remaining brown share relates to business activities that

11 See 5.1.2 for explanations of the calculation methods.

are at odds with the goal of mitigating climate change. It includes financing provided by a small number of promotional and development banks for fossil fuel production or the aviation sector.

The decline in the brown share is indicative of the sustainable investment strategy for foreign currency reserves that the Bundesbank introduced at the beginning of 2023. This strategy has seen the Bundesbank discontinue purchases of bonds issued by promotional and development banks with comparatively high brown shares of business activities (e.g. substantial financing of fossil fuel production). Existing holdings of bonds issued by these promotional and development banks will be run off as they mature.

5.2.1.3 International norms and other sustainability factors

In accordance with the sustainable investment strategy for the foreign currency reserves in the reserve assets, promotional and development banks are screened for compliance with minimum standards on an ongoing basis. The negative screening for breaches of international norms is grounded in norm-based assessment by the ESG data provider ISS ESG. As at the reporting date of 31 December 2023, the reserve assets/foreign currency reserves did not include any investments in promotional and development banks for which ISS ESG had detected serious proven (e.g. legally) breaches of international standards. Nor did ISS ESG identify any involvement in controversial weapons. The investments in promotional and development banks thus meet the minimum standards enshrined in the sustainable investment strategy.

The sustainable investment strategy for investments in promotional and development banks as part of the reserve assets does not include any targeted purchases of green bonds (or comparable forms of bonds). Accordingly, green bonds accounted for only a small share of the investment volume as at 31 December 2023, at 2.7%.

5.2.2 Sovereign and sub-sovereign investments

For the most part, the sovereign and sub-sovereign assets in the reserve assets comprise sovereign investments, above all US bonds, which thus have a particularly strong impact on the climate metrics (see Table 1). Furthermore, they include deposits with the central banks of the relevant sovereigns[12] and bonds of sub-sovereigns (regions of a country, such as federal states).

12 To calculate GHG and climate metrics, deposits with central banks are treated like, and added to, sovereign bonds. As a result, data on sovereigns are applied to both.

Reserve assets: holdings of investments in sovereigns and sub-sovereigns Table 3

		At the reporting date:		
		31.12.2021	31.12.2022	31.12.2023
Portfolio holdings (by nominal value)	**Total**	**€25.15 billion**	**€26.43 billion**	**€25.64 billion**
	United States	€20.89 billion	€22.28 billion	€21.64 billion
	Canada	€1.64 billion	€1.60 billion	€1.56 billion
	Japan	€1.56 billion	€1.44 billion	€1.30 billion
	Australia	€0.79 billion	€0.82 billion	€0.88 billion
	China	€0.26 billion	€0.28 billion	€0.27 billion

Sub-sovereigns are treated as distinct entities in the calculation of most GHG and climate metrics (with the exception of total carbon emissions and carbon footprint). This means that regional GHG emissions and production volumes of fossil fuels are taken into account for sub-sovereigns and set in relation to regional GDP adjusted by purchasing power parity (PPP).

Compared with the investments examined above (euro portfolio; investments in promotional and development banks in the reserve assets), the GHG metrics do overlap to a degree in terms of their designations and purposes. For sovereigns and sub-sovereigns, though, the variables that feed into the calculations differ in some cases (e.g. GDP adjusted by PPP rather than revenue). Accordingly, the results set out below are only comparable within the sovereign and sub-sovereign asset classes.

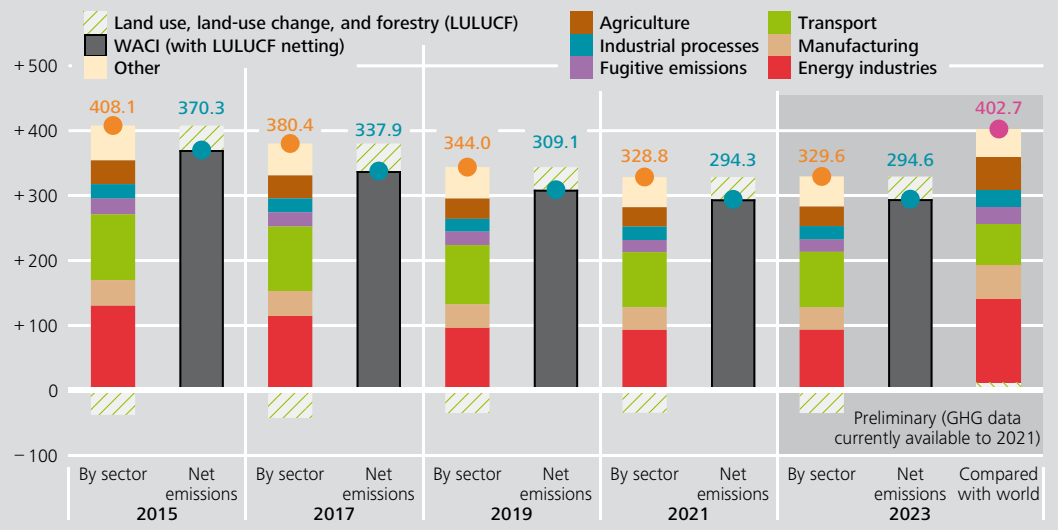
5.2.2.1 GHG metrics

Because sovereign GHG data are available only with particularly long lead times and only up to 2021 when this report was prepared, relatively longer horizons are examined for the GHG metrics set out below. GHG metrics are calculated both with and without the land use, land-use change, and forestry sector (LULUCF). For this reason, they are disclosed twice for each year, with the difference being due to the positive or negative GHG emissions from LULUCF.

Sovereigns and sub-sovereigns (reserve assets): WACI breakdown by sector and WACI by net emissions (netted for LULUCF)

Figure 9

in tCO_2e/€mn of GDP adjusted by PPP



Sources: UNFCCC, World Resources Institute, World Bank, Australian Government, Australian Bureau of Statistics, Bundesbank data and Bundesbank calculations.

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Since 2015 – the year of the Paris Climate Summit – there has been a steady decline in the WACI of sovereign and sub-sovereign investments (with the exception of the provisional WACI for 2023) (see Figure 9). WACI reductions can be attributed notably to the energy industries and transport sectors, though these still account for the bulk of the WACI.

As at 31 December 2023, WACI was well below the global GHG intensity, at 294.6 tCO_2e/€mn of GDP adjusted by PPP (after netting for LULUCF). This is partly because, in the sovereigns that issued the reserve assets, LULUCF capture or prevent larger volumes of GHG than they emit, while the opposite is the case globally. In addition, emissions from energy industries and agriculture, in particular, are lower in the sovereigns that issued the reserve assets relative to the size of the economy overall. Higher (relative) emissions are produced by the transport sector, by contrast.

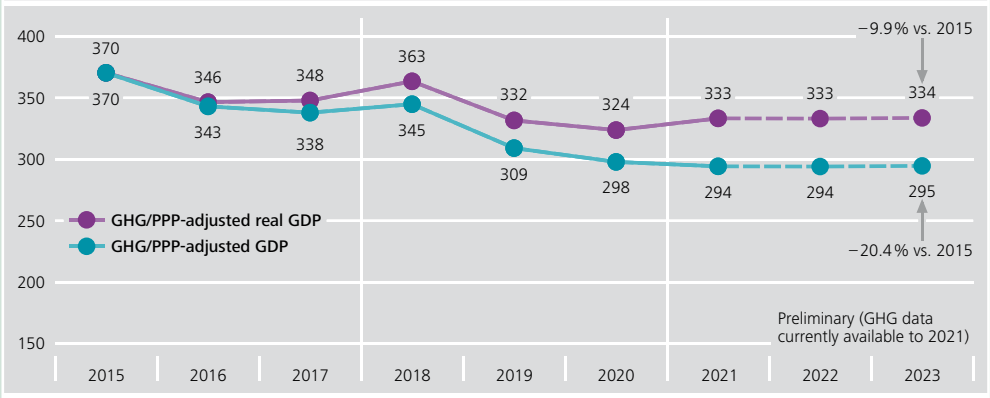
Box 2:

To what extent does inflation drive WACI reductions?

Owing to the financial reference variables used in the conventional calculation formulae, there is a risk that inflation might distort the GHG metrics. As a case in point, an inflation-driven increase in entities' revenues or in GDP would bring about a reduction in WACI even if the GHG emissions themselves remain unchanged.

Using the sovereign and sub-sovereign investments in the reserve assets as an example, this box explores ways to contextualise the impact of inflation on reductions in WACI.

Sovereigns and sub-sovereigns: half of reduction in WACI since 2015 due to inflation Figure 10



Sources: UNFCCC, World Resources Institute, World Bank, Australian Government, Australian Bureau of Statistics, Bundesbank data and Bundesbank calculations.

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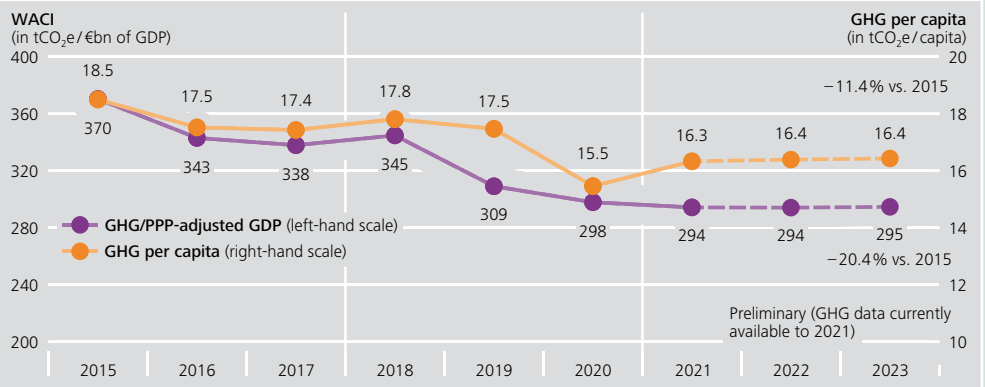
The method used hitherto to calculate sovereign WACI uses GDP adjusted by purchasing power parity as a financial reference variable. Purchasing power parity only reflects changes in purchasing power between sovereigns, however. Calculating WACI using real GDP adjusted by purchasing power parity as well allows inflation in all the sovereigns and sub-sovereigns under observation to be taken into consideration as well. 2015 is used as the base year for this purpose. If GDP is adjusted for inflation for all subsequent years using this approach, the WACI reduction up to 2023 comes to only 9.9% rather than 20.4% (see Figure 10). Hence, around half of the reduction could be put down to inflation.

Sovereigns and sub-sovereigns: comparison of WACI with per capita emissions

Figure 11



Sources: UNFCCC, World Resources Institute, World Bank, Australian Government, Australian Bureau of Statistics, Bundesbank data and Bundesbank calculations.

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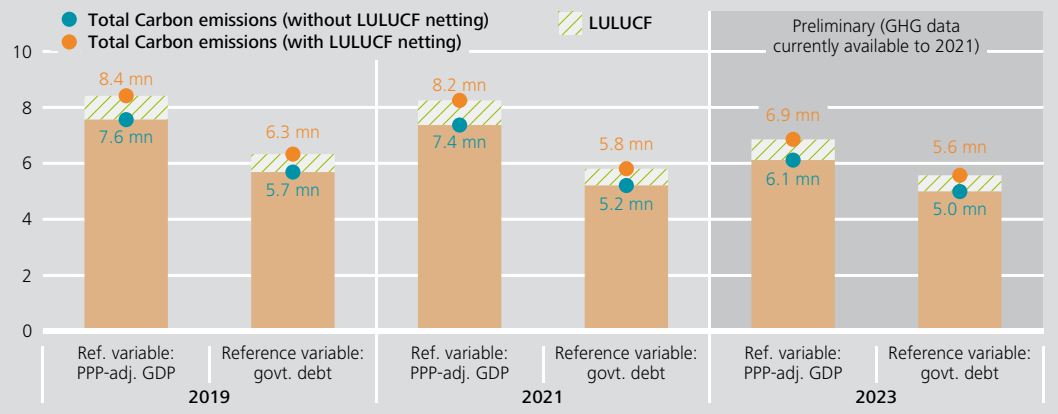
Another robustness test can be performed using per capita emissions. These provide another avenue for calculating the GHG intensity of sovereigns and sovereign-related investments. If the size of the population, rather than GDP, is used as the reference variable, the WACI reduction is likewise just under half as large, at 11.4% between 2015 and 2023 (see Figure 11). Concerning the temporary declines in economic output in 2020 caused by the COVID-19 pandemic, by contrast, GHG emissions relative to GDP turn out to be more robust to brief deviations from the long-term trend.

Overall, there are clear indications suggesting that declines in GHG metrics might be significantly overestimated if they are not adjusted for inflation. It should be noted that the increased inflation rates observed since 2022 have not yet been factored into WACI trajectories discussed in this box, as sovereign and sub-sovereign GHG data are currently only available up until 2021.

Sovereigns and sub-sovereigns (reserve assets): total carbon emissions based on different calculation methods Figure 12

in mn tCO_2e



Sources: UNFCCC, World Resources Institute, World Bank, Australian Government, Australian Bureau of Statistics, Bundesbank data and Bundesbank calculations.

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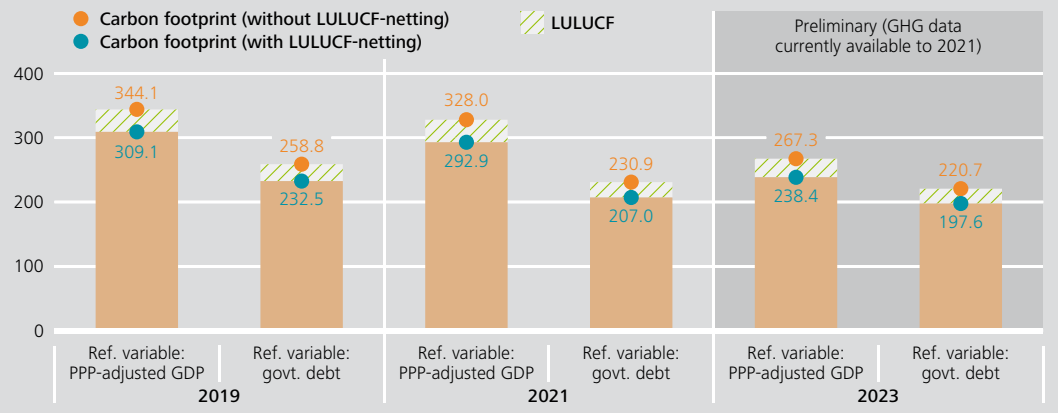
Total carbon emissions declined between 2019 and 2023 according to both calculation methods, i.e. with both GDP adjusted by PPP and government debt being used as the reference variable (see Figure 12). While total carbon emissions for 2021 and 2023 are both based on GHG data for 2021, there was an increase between the two reporting dates in both GDP adjusted by PPP and government debt – the two reference variables used for the volume of bonds in the portfolio. According to the formulae used to calculate total carbon emissions, then, the reserve assets (given a largely stable portfolio volume) are assigned smaller shares of sovereign GHG emissions, thus lowering the total carbon emissions.

The **carbon footprint**, which sets total carbon emissions in relation to the portfolio volume, follows a similar trend, given that the portfolio volume remained broadly stable in the 2019-23 period (see Figure 13).

Sovereigns and sub-sovereigns (reserve assets): carbon footprint based on different calculation methods

Figure 13

tCO_2e/€mn of investment



Sources: UNFCCC, World Resources Institute, World Bank, Australian Government, Australian Bureau of Statistics, Bundesbank data and Bundesbank calculations.

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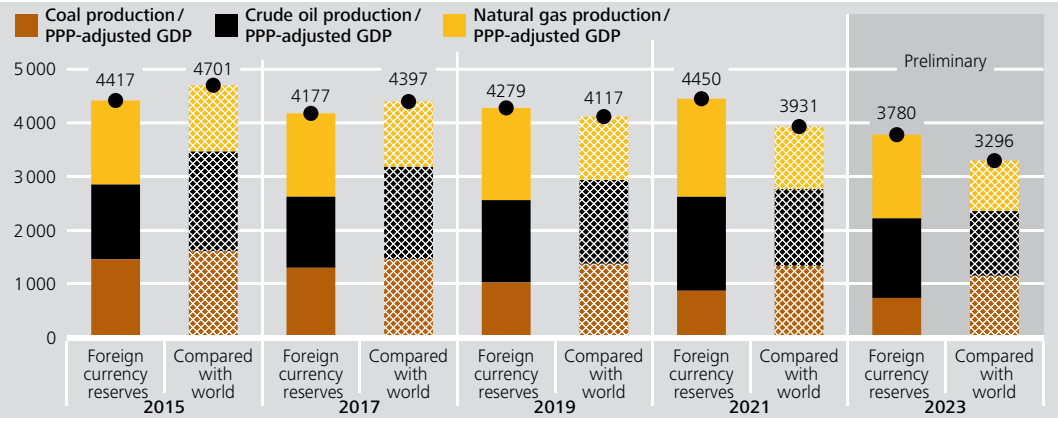
5.2.2.2 Production volumes of fossil fuels

By analysing production volumes of fossil fuels, it is possible to obtain additional insights into the climate performance of sovereign and sub-sovereign investments. For one thing, exports of fossil fuels involve indirect emissions that are not covered by the available GHG data. For another, the economic dependency of countries and regions on coal, crude oil and natural gas production involve climate-related financial risks. It is important to take these risks into account, not least in the wake of the UN Climate Change Conference in Dubai in 2023 (COP28), which saw the international community agree to phase out fossil fuels.

Sovereigns and sub-sovereigns (reserve assets): production volumes of fossil fuels (relative to size of the economy)

Figure 14

(in terajoules/€mn GDP adjusted by PPP)



Sources: International Energy Agency, World Bank, Australian Government, Australian Bureau of Statistics, Bundesbank data and Bundesbank calculations.

Deutsche Bundesbank

As at 31 December 2023, the production volume of coal relative to the size of the economy is significantly lower than the global average (see Figure 14). By contrast, both the production volume of crude oil and the production volume of natural gas relative to the size of the economy are higher than the global level. Looking at developments since 2015, the coal production volume has roughly halved relative to the size of the economy. Crude oil and natural gas production volumes, on the other hand, have stagnated relative to the size of the economy, compared with a slight decline worldwide.

5.2.2.3 Physical climate risks

Physical climate risks result from a changing climate, with a rise in the sea level, floods, hurricanes & typhoons, heat stress, droughts and wildfires being analysed in the following.

The analyses are based, first, on granular geographical data on projected climate changes up to 2040. Economic and financial risks to sovereigns, sub-sovereigns and related investments arise in particular when areas with high population density and economic concentration are affected. Therefore, for the sovereigns and sub-sovereigns that issued the reserve assets, the following section analyses which shares of the population, GDP and agricultural land are attributable to areas that are exposed to high physical risks according to Moody's ESG data. Here again, sovereigns and sub-sovereigns are aggregated by their weighted averages reflecting their shares in sovereign and sub-sovereign investments.

Sovereigns and sub-sovereigns (reserve assets): physical climate risks Figure 15

in %

Sources: Moody's ESG, Bundesbank data and calculations.
Deutsche Bundesbank

The analysis reveals that all six forms of climate change under analysis are materially important for the sovereigns that issued the reserve assets (see Figure 8). High drought and heat stress risks, in particular, affect relatively large shares of the population, GDP and agricultural land. As one would intuitively expect, there are large overlaps between the population and GDP distribution. A rise in the sea level stands out as an exception here. The discrepancy shown by this variable suggests that, while a high risk of a rising sea level affects only small parts of the population, it impacts coastal regions that are particularly strong economically.

5.2.2.4 Further sustainability factors

The sustainable investment strategy for sovereign and sub-sovereign investments as part of the reserve assets does not include targeted purchases of green bonds (or comparable forms of bonds). Accordingly, green bonds accounted for only a very small share of the investment volume as at 31 December 2023, at 0.01%.

5.2.3 Sustainability analysis of the Bundesbank's gold holdings and of gold as an asset class

Gold is an important component of reserve assets worldwide and thus represents a significant asset class for central banks. Many central banks add to their stocks of gold in times of economic uncertainty in particular. Investments in gold cannot default, which means they simultaneously serve the important function of cementing public confidence in the central bank. Therefore, the climate and sustainability-related aspects of gold investments are also generally relevant in any comprehensive climate and sustainability-related analyses of central banks' business activities.

5.2.3.1 Climate performance of the Bundesbank's gold holdings: a hypothetical analysis

Gold is a key asset class for the Bundesbank as well, accounting for the vast majority of its reserve assets. The Bundesbank's gold holdings were built up between 1951 and 1973 as a result of current account surpluses and currency crises during the Bretton Woods monetary system. At the end of 2023, the gold holdings had been held for around 61 years on average. The gold's climate and sustainability performance depends in large measure on the sources of production, which have to be analysed retrospectively for the gold already held by the Bundesbank. However, it is no longer possible to determine when, where and how the gold contained in the bars was originally mined and melted. The fact that gold is

a homogeneous commodity makes this endeavour more challenging still. In addition, empirical insights into GHG emissions around historical gold production methods are extremely limited.

For these reasons, it is not possible to chart a "real" GHG performance at the points in time when the gold was actually produced. Even so, to get a rough idea of the size of the GHG footprint, we hypothetically analyse an amount of gold that is equal to the Bundesbank's gold holdings and was obtained according to the global mix of today's gold production. This exercise was based on study findings and financial market reports on the GHG performance of gold production from the present day or recent past. These show that mining for gold represents the most GHG-intensive and, at the same time, largest share of annual gold production (74%).[13] The remaining shares of gold production can be attributed to high-value gold scrap recycling (23%) and electronic waste recycling (3%), which cause significantly lower emissions.

Furthermore, gold holdings involve operational GHG emissions because they need to be stored and guarded. These emissions are comparatively low, however, and are not included in the scope of this analysis.[14]

Study results on global gold production Table 4

		Mining		Recycling of	
				High-value gold scraps	Electronic waste
Share of global gold production[15]		**74%**		**23%**	**3%**
		Scope 1 + 2	**Scope 3 (upstream)**		
GHG intensity according to literature (in tCO_2e/tonne of gold produced)	**Smallest value**[16]	13,900	7,287	53	1,000
	Median[17]	23,300			
	Largest value[18]	29,242			

Values rounded.
Sources (see footnotes): Fritz et al. (2020), Mudd (2010), S&P Global Market Intelligence (2023), Ulrich et al. (2022), and Bundesbank calculations.

13 Fritz et al. (2020), Environmental impact of high-value gold scrap recycling
14 Operational GHG emissions are covered in the Bundesbank's Environmental Report and are not analysed in this report. perational GHG emissions are covered in the Bundesbank's Environmental Report and are not analysed in this report.
15 Fritz et al. (2020), Environmental impact of high-value gold scrap recycling
16 Mudd (2010), The environmental sustainability of mining in Australia: key mega-trends and looming constraints.
17 Ulrich et al. (2022): Gold mining greenhouse gas emissions, abatement measures, and the impact of a carbon price.
18 S&P Global Market Intelligence (2023), GHG and gold mines – Canada emissions drop the most (accessed on 25 April 2024).

The available studies arrive at different results for the GHG intensity (scope 1 & 2) of gold mining (see Table 4). This report therefore discloses the GHG footprint of the gold holdings as an interval, with the lowest and highest levels of GHG intensity shown in the literature being assumed. The fact that the actual sources from which the Bundesbank's gold holdings were produced are unknown likewise suggests that the Bank should refrain from reporting a supposedly precise GHG footprint.

As at the reporting date of 31 December 2023, the Bundesbank's gold holdings amounted to 3,353 tonnes. For this amount of gold, the GHG footprint computed according to the hypothetical approach described above would amount to between 52.8 and 90.8mn tCO_2e. Expressed relative to the market value of the gold holdings as at 31 December 2023 (€201.3bn), this would equate to a carbon footprint of between 262 and 451 tCO_2e/€mn of investment.

These figures are not, however, comparable with those for securities investments in corporations and governments. The latter represent ongoing annual emissions, while the figures for the gold holdings reflect one-off GHG emissions related to the production of the gold. For a meaningful comparison to be made, the gold's carbon footprint would have to be spread over the gold's useful life. The longer the gold is held, or the longer it is used, the smaller an "annualised" footprint calculated in this way becomes. Based on the average holding period of the Bundesbank's gold (currently around 61 years), the annualised carbon footprint would amount to around 4 to 7tCO_2e/€mn of investment and continue to decline in the future.[19] Spread over such a long holding period, then, the Bundesbank's gold holdings provide a more GHG-efficient store of value than conventional securities investments.

5.2.3.2 General sustainability assessment of gold as an asset class

For new investments in gold, all manner of sustainability factors can be used to assess the sustainability of different gold sources, information permitting. The **ecological footprint** of gold investments is determined primarily by the one-off climate and environmental impacts of producing gold. These can vary greatly depending on the origin of the gold. Thus, industrial-scale gold mining represents a comparatively GHG-intensive source of production, especially in cases where large quantities of fuel and electricity from fossil energy sources are used. Furthermore, if mining involves environmental impacts such as deforestation, the ability to capture greenhouse gases may be impaired in the long term.[20] Recycling electronic waste containing gold and, in particular, high-value gold scraps to produce gold, is comparatively more climate-compatible (see Table 4).

19 In addition, changes in the market price of gold may also have an impact on the carbon footprint.
20 See Timsina et al. (2022), Tropical surface gold mining: A review of ecological impacts and restoration strategies

While gold holdings involve operational GHG emissions because the gold needs to be stored and guarded, these emissions are comparatively low. Therefore, it is almost entirely the one-off GHG emissions caused by gold production that are of primary importance. If gold investments are made up mostly of previously mined gold – and recycled gold in particular – they can serve as a low-GHG means of storing value.

There are other environmental impacts as well which can differ significantly depending on the source of the gold. Nature and biodiversity risks exist primarily if gold mining takes place in rainforest regions that are rich in flora and fauna.[21] Furthermore, depending on how the gold is mined, chemicals may be used that can contaminate bodies of water.[22] These impacts are smaller if more environmentally friendly production methods are used, especially gold recycling.

In addition, the **social aspects** of investments in gold are multifaceted and depend on the origin of the gold. In scantly regulated artisanal and small-scale gold mining, for example, there is a greater risk that working conditions will be precarious and hazardous to workers' physical well-being.[23] In addition, potential environmental impacts caused by gold mining can put the native population at risk. Recycling gold would also limit the social impacts associated with this. Regulatory standards, together with developments in the countries of production and in trade policy, also have a major bearing in this regard.[24]

5.3 Targets and outlook

In future, the Bundesbank will continue to take account of the consequences of climate change and climate policy in the management of its non-monetary policy financial assets, and in so doing, will endeavour in particular to address climate-related financial risks. Alongside this, within the framework of its legal mandate, the Bank could also, in principle, consider climate protection aspects such as potential decarbonisation paths as part of the efforts towards achieving the goals of the Paris Climate Agreement as well as the climate neutrality goals of the Federal Republic of Germany and the EU.

21 See World Bank Group (2019), Forest-Smart Mining – Identifying Good and Bad Practices and Policy Responses for Artisanal and Small-Scale Mining in Forest Landscapes (accessed on 25 April 2024).
22 See Deutschlandfunk (2020), Goldabbau in Kolumbien – Widerstand für Trinkwasser (accessed on 25 April 2024).
23 See WWF (2021), The Impact of Gold – Sustainability Aspects in the Gold Supply Chains and Switzerland's Role as a Gold Hub, pp. 36 f. (accessed on 25 April 2024).
24 See EU, Conflict Minerals Regulation (accessed on 26 April 2024).

Such aims must consistently align with the essential objectives of the financial investments. It lies in the nature of foreign currency portfolios, as part of the reserve assets, that they are concentrated on specific currencies as well as secure and liquid forms of investment. Furthermore, the potential implementation of concrete climate-related targets requires that suitable points of reference for the measurement and management of target achievement exist. As explained in this report, GHG metrics are of limited suitability when referring solely to scope 1 and 2 emissions if they are of minor significance compared with scope 3 emissions. This is currently the situation of the Bundesbank's euro portfolio. A more suitable approach could be to assess the green and brown shares of the securities issuers' business activities and to aim for a climate-friendly development of these shares (see Section 5.2.1.2).

Over the short to medium term, the Bundesbank aims to, in particular, further advance the quality and coverage of sustainability data, such as data on the scope 3 emissions of financial institutions. The sustainable investment policies for the euro portfolio and the foreign currency portion of the reserve assets should be advanced and improved against the backdrop of the progress made in these areas. The Bundesbank's annual climate-related reporting is, in this connection, an important part of the observation and disclosure process.

ANNEX

I Greenhouse gas and climate metrics: background information and methods

"Carbon" as a synonym for greenhouse gases (GHG)

In this report, "carbon" is used as a synonym for GHG emissions, in line with widespread use in the area of GHG metrics. However, the term "carbon" is misleading, as the GHG metrics do not cover carbon dioxide (CO_2) alone but also other greenhouse gases within the meaning of the Kyoto Protocol, such as methane (CH_4) and nitrous oxide (N_2O).

Greenhouse gas	Share of global emissions (expressed as CO_2e)[25]	Examples of major sources
Carbon dioxide (CO_2)	74%	• Burning of fossil fuels • Manufacture of cement
Methane (CH_4)	17%	• Agriculture: cattle farming • Natural gas: leaks during extraction, transport
Nitrous oxide (N_2O)	6%	• Agriculture: use of fertilisers
Other	2%	

CO_2e as a unit for greenhouse gases

The various greenhouse gases are measured by their GHG or warming effects in CO_2e (CO_2 equivalents) or tCO_2e (tonnes of CO_2 equivalents).

25 Bundesbank calculation based on data from the World Resources Institute (WRI) on global GHG emissions in 2020.

Quantities of GHG emissions worldwide and in Germany

Annual global GHG emissions are around 48 billion tCO_2e.[26] In Germany, they amount to around 760 million tCO_2e. This means that average per capita emissions in Germany are just under 9 tCO_2e.

II GHG and climate metrics on the euro portfolio and investments in promotional and development banks

Source of GHG data

To calculate GHG metrics for Bundesbank investments in banks, GHG data derived from the banks' disclosures (e.g. sustainability reports) are used. The Bundesbank obtains relevant data from the ESG data provider ISS ESG. Data on GHG emissions modelled or estimated by data providers are not included in the calculations.

Lead times for GHG data and retroactive updates of GHG metrics from previous portfolio reference dates

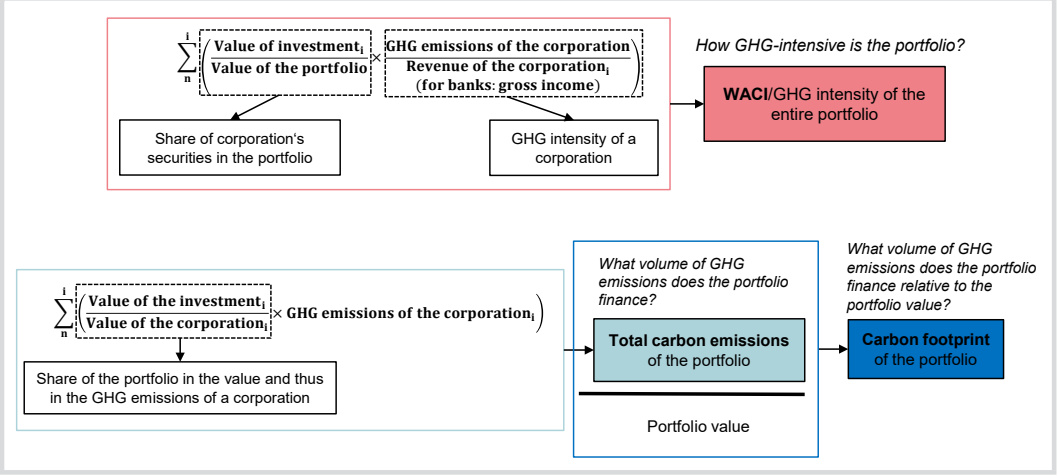
In principle, the aim is to ensure that portfolio holdings and GHG data refer to the same year, insofar as data availability permits. However, for the reporting dates of both 31 December 2022 and 31 December 2023, the GHG metrics are based on data on banks' GHG emissions in 2022. As this report went to press, these were the most recent GHG data available and were therefore also used for the portfolio reference date of 31 December 2023. For next year's climate-related disclosures, the plan is to adjust the corresponding calculations retroactively using GHG data for 2023. For the present disclosures, the GHG metrics for the portfolio as at 31 December 2022 have been adapted to GHG data for 2022 (for 2021 in last year's disclosures), following this principle.

26 Bundesbank calculation based on data from the World Resources Institute (WRI) on global GHG emissions in 2020.

Scope 1, 2 and 3 GHG emissions

Category		Comprises	Examples of sectors with comparatively high emissions
Scope 1		Direct GHG emissions	• Electricity producers • Producers of cement, steel • Airlines
Scope 2		Indirect GHG emissions from the production of purchased energy (primarily electricity)	• Heavy industry • Chemical companies
Scope 3	**Upstream**	Indirect GHG emissions along the value chain (except scope 2)	• Retail • Food companies
	Downs-tream		• Oil and gas producers • Manufacturers of cars, aircraft • Banks

Formulas for GHG metrics



III GHG and climate metrics for sovereign and sub-sovereign investments

Sources and measurement approaches for GHG data

The GHG data on sovereigns used in this report are mostly obtained from the United Nations Framework Convention on Climate Change (UNFCCC) data interface, where the UNFCCC lists GHG data recorded by sovereigns and reported to the UNFCCC. In cases where no recent GHG data are available for a given sovereign in the UNFCCC data interface, modelled GHG data from the World Resources Institute (WRI) are used for this report. The data are obtained using the production-based, or territorial, measurement approach: sovereigns are assigned those GHG emissions that occur within their borders or in their jurisdiction.

Production-based/territorial GHG emissions are also used for sub-sovereigns. The respective national authorities (e.g. statistical offices) serve as data sources.

GHG data based on the consumption-based measurement approach are not yet included in this report. This approach draws on foreign trade data. Unlike in the production-based approach, sovereigns are not allocated GHG emissions from exported goods but are additionally allocated GHG emissions from imported goods. However, various consumption-based methods have led, in part, to large discrepancies in GHG levels. This report therefore focuses on the well-established production-based approach.

Lead times for GHG data and retroactive updates of GHG metrics from previous portfolio reference dates

In principle, the aim is to ensure that portfolio holdings and GHG data refer to the same year, insofar as data availability permits. However, GHG data on sovereigns and sub-sovereigns have longer lead times than GHG data on corporations. At the time of reporting, the latest available GHG data refer to 2021. The GHG data for 2021 therefore serve as a provisional basis for the GHG metrics for the portfolio reference dates 31 December 2022 and 31 December 2023. To nonetheless provide a meaningful picture of developments in sovereigns' GHG profiles, comparatively longer periods are considered for the subsequent GHG metrics.

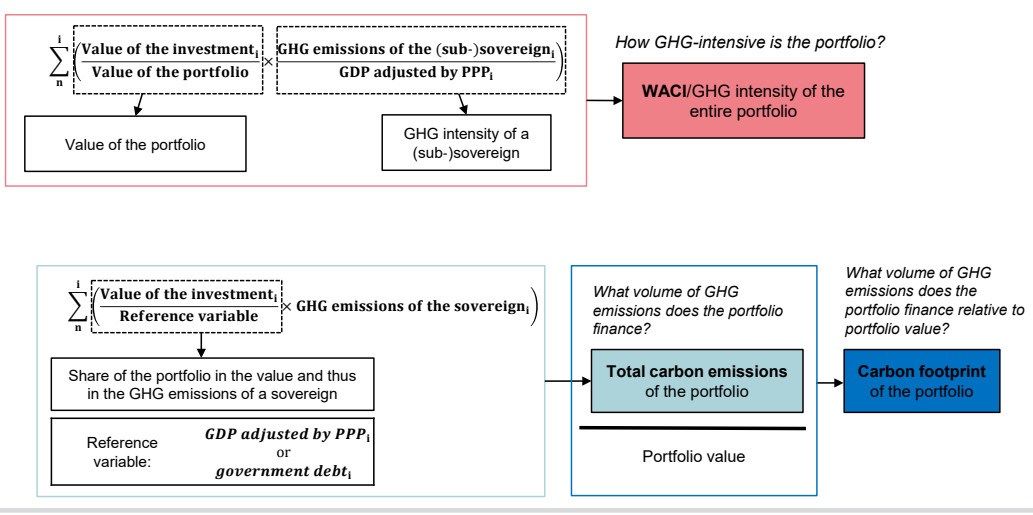
LULUCF (land use, land-use change, and forestry) as a GHG sector

Measurements of sovereign GHG emissions often differ in whether they include the land use, land-use change, and forestry (LULUCF) sector. For example, LULUCF can be a major – and sometimes the largest – source of GHG in densely wooded regions given deforestation. By contrast, reforestation may lead to negative emissions, resulting in an improved GHG profile. LULUCF then constitute GHG sinks.

LULUCF thus play an important role in many national and international climate objectives. However, in view of the complicated accounting of LULUCF, climate researchers still have reservations concerning the quality and comparability of such data.

The GHG metrics in this report are shown both with and without LULUCF.

Formulas for GHG metrics



Methodological caveats concerning the total carbon emissions and carbon footprint of sovereign and sub-sovereign investments

The methods for calculating the total carbon emissions and carbon footprint are not as well established for investments in sovereigns and sub-sovereigns as they are for investments in corporations. Methodological challenges notably include adequately measuring which shares of sovereigns are financed by investments in the portfolio.

Early climate-related disclosures often took **government debt** as the reference variable. Government bonds (held in a portfolio) do indeed account for a part of government debt. However, sovereigns and their GHG emissions are not financed through government debt alone. Under this approach, the financed emissions would therefore be overstated.

The PCAF recommends using **GDP adjusted by PPP** as the reference variable instead. Unlike government debt, GDP adjusted by PPP is clearly related to a sovereign's GHG emissions. However, the relationship between government bonds (held in a portfolio) and GDP adjusted by PPP is unclear.

Both approaches therefore have substantial downsides. Despite these reservations, this report includes the total carbon emissions and carbon footprint based on both approaches in order to contribute to the discussion of methodological developments and to provide insights into differences in results.

Production volumes of fossil fuels: methodology for the indicators

Production volumes of coal, crude oil and natural gas are measured by energy content in terajoules (TJ),[27] and are set in relation to the size of the economy (GDP adjusted by PPP), analogously to the WACI methodology. Weighted averages of the intensity of coal, crude oil and natural gas production volumes are calculated for sovereign and sub-sovereign investments on this basis.

27 In accordance with the International Energy Agency (IEA)'s standard for countries' energy balances.

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