REPORT

DANMARKS NATIONALBANK

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Disclosure of climate footprint of the foreign exchange reserve: Background and methodology

- For the first time, Danmarks Nationalbank discloses the climate footprint from parts of its foreign exchange reserve. With the disclosure, Danmarks Nationalbank aims to contribute to greater transparency about the climate footprint of financial portfolios, in line with other European central banks.
- The purpose of the foreign exchange reserve is to support Denmark's fixed exchange rate policy and the stability of the financial system. The foreign exchange reserve is invested as responsibly as possible with due consideration for these purposes.
- The disclosure covers both the holdings of bonds issued by governments and regional authorities and the holdings of equities and corporate bonds invested through exchange-traded funds. Disclosure is not possible for the remaining part of the foreign exchange reserve, as there is not sufficient data or widely accepted definitions of climate footprints for these asset classes.
- Danmarks Nationalbank has reduced the climate footprint from equities and corporate bonds in 2022, following a switch to exchange-traded funds that comply with the EU's Paris-Aligned Benchmark.

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For the first time, Danmarks Nationalbank discloses calculations of the climate footprint from the part of the foreign exchange reserve that is invested in securities issued by governments, regional authorities and companies. The disclosure measures emissions of greenhouse gases (CO_2e) from economic activity generated by the issuers.[1]

Disclosure of metrics for climate footprint is an example of climate-related disclosure. This type of disclosure has gained ground in recent years. This has occurred in conjunction with new regulations introducing stricter requirements for both financial and non-financial companies' disclosures as well as an increased focus by society on climate change and the green transition.[2] With its disclosure, Danmarks Nationalbank follows the standard for climate footprint transparency adhered to by other European central banks.[3]

Disclosure on the climate footprint of financial portfolios is still an evolving area

At present, it is not possible to fully quantify the climate footprint of a financial portfolio. A lower climate footprint in a given year may reflect both real CO_2e reductions in the underlying companies as well as changes in the market value of the underlying equities and corporate bonds. Therefore, one should be careful when interpreting fluctuations in the climate footprint of a given portfolio from year to year and instead interpret changes as indications.

The climate footprint metrics do not express the effect on actual CO_2e emissions of financing the activities of the issuers of securities in the foreign exchange reserve. Nor do the metrics express the effect on actual emissions from individual investors restructuring their investments.

The reported metrics cannot be used as a guideline for whether the issuers in the foreign exchange reserve comply with the Paris Agreement's climate goals.[4] The reason for this is that the calculations are based on *current* CO_2e emissions, whereas the Paris Agreement sets a goal of climate neutrality by 2050.

Purpose and composition of the foreign exchange reserve

The primary purpose of the foreign exchange reserve is to enable Danmarks Nationalbank to intervene in the foreign exchange market by buying and selling Danish kroner. Danmarks Nationalbank intervenes to ensure the fixed exchange rate policy against the euro and the stability of the Danish financial system. The climate footprint of the foreign exchange reserve is therefore not considered in Danmarks Nationalbank's active liquidity management.

Chart 1 shows the composition of the foreign exchange reserve across asset classes. To enable Danmarks Nationalbank to intervene at short notice, the foreign exchange reserve is primarily placed in short-term money market products (e.g. deposits with foreign central banks and reverse repo transactions) and liquid euro-denominated government bonds.

In addition to a liquid foreign exchange reserve, a secondary objective of the foreign exchange reserve is to realise the highest risk-adjusted return. Part of the foreign exchange reserve is therefore invested in equities and corporate bonds via exchange-traded funds, ETFs.[5]

The foreign exchange reserve is invested as responsibly as possible with due consideration for its purpose

Danmarks Nationalbank aims to invest its foreign exchange reserve in alignment with the climate goals

1 CO_2e abbreviates CO_2 equivalents. CO_2e converts all greenhouse gases associated with global warming into a common unit.

2 The Disclosure Regulation (SFDR), the Taxonomy Regulation and the Corporate Sustainability Reporting Directive (CSRD) lay down more stringent requirements for companies' disclosure.

3 See press releases from the European Central Bank (ECB), *Eurosystem agrees on common stance for climate change-related sustainable investments in non-monetary policy portfolios*, ECB, February 2021 (*link*) and *ECB takes further steps to incorporate climate change into its monetary policy operations*, ECB, July 2022 (*link*).

4 The Paris Agreement is an international, legally binding agreement from 2015 that aims to limit global warming.

5 ETF abbreviates *exchange-traded fund*. An ETF is a passive investment type in which the composition of the fund follows an underlying index.

of the Paris Agreement. However, a prerequisite for meeting this objective is that the foreign exchange reserve can fulfil its primary objective of supporting the fixed exchange rate policy and financial stability at the same time.[6]

Disclosure covers a minor part of the foreign exchange reserve

The disclosure covers the part of the foreign exchange reserve that is invested in bonds issued by central governments and regional authorities as well as ETFs. At the end of 2022, these asset classes amounted to approximately kr. 50 billion, equal to approximately 10 per cent of the market value of foreign reserves (excluding gold and loans from the International Monetary Fund), see chart 1.

The rest of the foreign exchange reserve and Danmarks Nationalbank's other financial portfolios are not part of the disclosure.[7] Currently, there are no widely accepted standards defining the climate footprint for these asset classes, and a lack of data further challenges such disclosure. Danmarks Nationalbank continuously monitors the development in metrics and data. It is Danmarks Nationalbank's ambition that its climate-related disclosure will eventually cover a larger part of the financial holdings as disclosure standards and data are developed.

Different methods for measuring climate footprint

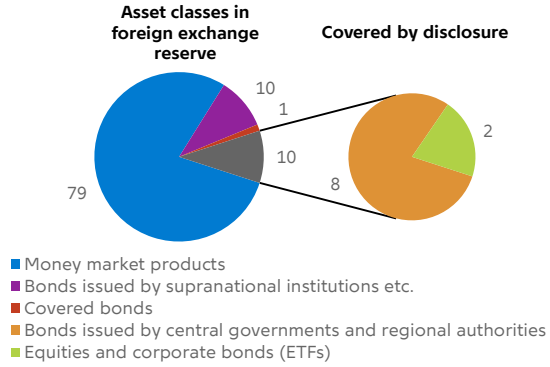
There exist different methods for measuring the climate footprint of a financial securities portfolio. This disclosure uses three metrics:

- Weighted average carbon intensity
- Absolute financed emissions
- CO_2e footprint.

10 per cent of the foreign exchange reserve consists of bonds issued by governments and regional authorities as well as equities and corporate bonds

Chart 1

Per cent



Note: The foreign exchange reserve is calculated at market value in Danish kroner as of 30 December 2022, excluding gold and IMF loans.
Source: Own calculations.

The calculations behind the metrics are elaborated on in box 1. Disclosure using these metrics follows the recommendations of the Statistics Committee of the European System of Central Banks for measurement of climate footprints at the portfolio level. The metrics are also recommended by, for example, the organisations Network for Greening the Financial System and Task Force on Climate-related Financial Disclosures.[8]

Weighted average carbon intensity

The carbon intensity of a security is calculated based on the issuer's total CO_2e emissions relative to the value of the economic activity that the issuer generates. If the issuer is a country, the value of the economic activity is determined by the country's gross domestic product (GDP). If the issuer is a company, the value of the activity is determined by the revenue generated by the company.

6 Danmarks Nationalbank's role in the green transition is elaborated in the analysis Climate change and the role of central banks, *Danmarks Nationalbank Analysis*, No. 19, July 2021.

7 In addition to the foreign exchange reserve, Danmarks Nationalbank's financial holdings consist of the domestic securities portfolio (Danish mortgage bonds), loans to banks and mortgage credit institutions as well as gold and deposits with the International Monetary Fund.

8 See *Recommendations of the Task Force on Climate-related Financial Disclosures,* Financial Stability Board, June 2017 (*link*), *Guide on climate-related disclosure for central banks*, Network for Greening the Financial System, December 2021 (*link*) and *Towards climate-related statistical indicators*, Statistics Committee of the European System of Central Banks, January 2023 (*link*).

Calculation of climate footprint

Box 1

Methods for calculating the climate footprint of a financial portfolio (1) **allocates CO_2e emissions to an issuer**, (2) **attributes emissions to securities** and possibly (3) **normalises emissions**. This box shows the formulas used to calculate the climate footprint of the foreign exchange reserve, including allocation, attribution and normalisation.

Bonds from governments and regional authorities

The climate footprint of bonds issued by governments and regional authorities is calculated using the formulas below. *Government bonds* cover both actual government bonds and bonds issued by a given country's regional authorities. *N* indicates the number of countries in the portfolio. Danmarks Nationalbank's holdings and the issuers' total issuances of bonds have been calculated at nominal value.

Weighted average carbon intensity (WACI) for portfolio:

$$\sum_{i=1}^{N} \frac{\text{portfolio of government bonds issued by country } i}{\text{total portfolio of government bonds}} \cdot \frac{\text{emissions from country } i}{\text{GDP in country } i}$$

Absolute financed emissions for portfolio:

$$\sum_{i=1}^{N} \frac{\text{portfolio of government bonds issued by country } i}{\text{total government bonds issued by country } i} \cdot \text{emissions from country } i$$

CO_2e footprint for portfolio:

$$\left(\sum_{i=1}^{N} \frac{\text{portfolio of government bonds issued by country } i}{\text{total government bonds issued by country } i} \cdot \text{emissions from country } i\right) / \text{total portfolio of government bonds}$$

Equities and corporate bonds (ETFs)

The climate footprint for ETFs is defined by the formulas below. The formulas are based on recommendations from the Statistics Committee of the European System of Central Banks and Task Force on Climate-related Financial Disclosures.[1] *N* indicates the number of securities in the ETF. The WACI and CO_2e footprint for Danmarks Nationalbank's total holding of ETFs have been calculated as weighted averages of the WACI and CO_2e footprints for the individual ETFs, where the ETFs have been weighted with their respective market values in the portfolio. The absolute emission from Danmarks Nationalbank's portfolio has been finally calculated on the basis of the CO_2e footprint of the portfolio.

Weighted average carbon intensity (WACI) for each individual ETF:

$$\sum_{i=1}^{N} \frac{\text{market value of shares and bonds from company } i \text{ in ETF}}{\text{market value of ETF}} \cdot \frac{\text{emissions from company } i}{\text{revenue in company } i}$$

Absolute financed emissions for each individual ETF:

$$\sum_{i=1}^{N} \frac{\text{market value of shares and bonds from company } i \text{ in ETF}}{\text{EVIC for company } i} \cdot \text{emissions from company } i$$

CO_2e footprint for each individual ETF:

$$\left(\sum_{i=1}^{N} \frac{\text{market value of shares and bonds from company } i \text{ in ETF}}{\text{EVIC for company } i} \cdot \text{emissions from company } i\right) / \text{market value of ETF}$$

EVIC is an abbreviation of *Enterprise Value Including Cash*. EVIC indicates the total value of the company, i.e. the market value of equity, credits and debt.

1. See *Implementing the Recommendations of the Task Force on Climate-related Financial Disclosures*, Financial Stability Board, October 2021 (*link*) and *Towards climate-related statistical indicators*, Statistics Committee of the European System of Central Banks, January 2023 (*link*).

A popular climate footprint metric is *weighted average carbon intensity* (WACI). WACI states the average carbon intensity of the portfolio where the securities are weighted according to their respective share of the total portfolio.

One advantage of WACI is that it normalises the emissions of the portfolio with the economic activity generated by the issuers. It is therefore possible to compare a given portfolio across time and across different portfolios. For example, if economic activity and emissions doubled, WACI would be unaffected. Another advantage is that portfolios of different sizes can be compared, as WACI provides an average and therefore does not depend on the size of portfolios.

Comparisons over time are affected by WACI usually being stated in current prices, so that issuers' economic activity is not adjusted for inflation. This means that changes in the volume produced are conflated with both general price developments in a country or company and fluctuations in exchange rates. This obscures the comparison. In a situation with general price increases, the carbon intensity will decrease without less CO_2e being emitted per unit produced.

The Task Force on Climate-related Financial Disclosures and Network for Greening the Financial System both recommend using WACI as the primary method for measuring a climate footprint. The reason for this is that WACI normalises emissions with economic activity. Thus, other things being equal, a country or company with large CO_2e emissions relative to economic activity will be more vulnerable to requirements for fewer emissions than a country or company with low emissions relative to economic activity.

Absolute financed emission

The *absolute financed emission* of a security is the issuer's CO_2e emission attributed proportionally to the ownership share of the issuing country's total debt or the company's total value covered by the security.[9] The absolute emission of a portfolio is the sum of the absolute emission of the individual securities.

The absolute financed emission of a portfolio is not normalised with the size of the portfolio or the underlying economic activity. Other things being equal, large portfolios thus have higher absolute emissions than small portfolios. It may therefore be difficult to compare absolute emissions over time and across portfolios. For example, it is unclear whether fewer emissions from a portfolio is due to the portfolio being smaller, or the reason is that the issuers' economic activity has decreased or that the production takes place in a less polluting way. For bonds issued by governments and regional authorities, fewer emissions may also be due to the total issuance of bonds having grown without the portfolio having been increased proportionally.

CO_2e footprint

The *CO_2e footprint* of a portfolio states the associated absolute financed emissions relative to the value of the portfolio. Accordingly, like WACI, the CO_2e footprint can be used to compare different portfolios.

The value of portfolios is usually calculated at current prices. The normalisation of absolute emissions with the size of the portfolio thus does not adjust for inflation over time. A CO_2e footprint will therefore automatically fall in a situation with a general price development. This is not the case with absolute emissions, as this metric does not normalise emissions.

9 For bonds issued by governments and regional authorities, the CO_2e emission has been attributed on a pro rata basis in accordance with Danmarks Nationalbank's ownership share of the issuing country's total debt. This approach ensures that a country's total calculated funded emissions across investors sums to the country's total actual emissions. The approach has, for example, been used by the Dutch central bank for its climate-related disclosure, see *Annual Report 2020*, De Nederlandsche Bank, August 2021 (*link*) and *Annual Report 2021*, De Nederlandsche Bank, May 2022 (*link*).

Reflections on data

This section presents reflections on and limitations of the data used in the calculations. The individual data sources are stated in the appendix.

Bonds issued by governments and regional authorities are disclosed together

Emissions associated with bonds issued by governments and regional authorities have been allocated based on the total CO_2e emissions of the respective countries. This means that bonds from regional authorities are allocated emissions as if these bonds were issued by the country's central government.

One advantage of this approach is that it is consistent with the funding of a regional authority being similar to the funding of a central government, as funds raised by central governments are often transferred to regional budgets. Another advantage of the approach is that it does not rely on data for regional CO_2e emissions, which can be difficult to obtain.

Emissions associated with governments and regional authorities are allocated on a production basis

The CO_2e emissions associated with bonds issued by governments and regional authorities have been allocated on the basis of the total emissions from the production of goods and services within the individual issuing country's borders.

The production-based approach is recommended by the Network for Greening the Financial System and has been chosen for several reasons. Firstly, data for countries' CO_2e emissions are more easily and quickly available than data for countries' consumption-based emissions.[10] Secondly, the production-based approach aligns with the line of thought in the United Nations Framework Convention on Climate Change and the Paris Agreement, which require countries to reduce CO_2e emissions within their borders. Thirdly, the production-based approach is, in practice, the most widely used approach to climate-related disclosure for government bonds.

However, the production-based approach also has disadvantages. The approach entails a double counting of emissions across asset classes. For example, emissions from a German company, of which Danmarks Nationalbank owns a part via ETFs, are allocated to both German government bonds and to the ETF in which the company is included. In addition, the production-based approach does not register CO_2e leakage, i.e. that outsourcing of production reduces a country's or company's climate footprint without reducing the global climate footprint.

The allocation to companies covers direct emissions and emissions associated with purchases of energy

CO_2e emissions associated with companies are usually divided into scopes:

- Scope 1: The company's direct emissions
- Scope 2: The company's indirect emissions from purchases of energy
- Scope 3: Other indirect emissions associated with production and consumption of the company's products.

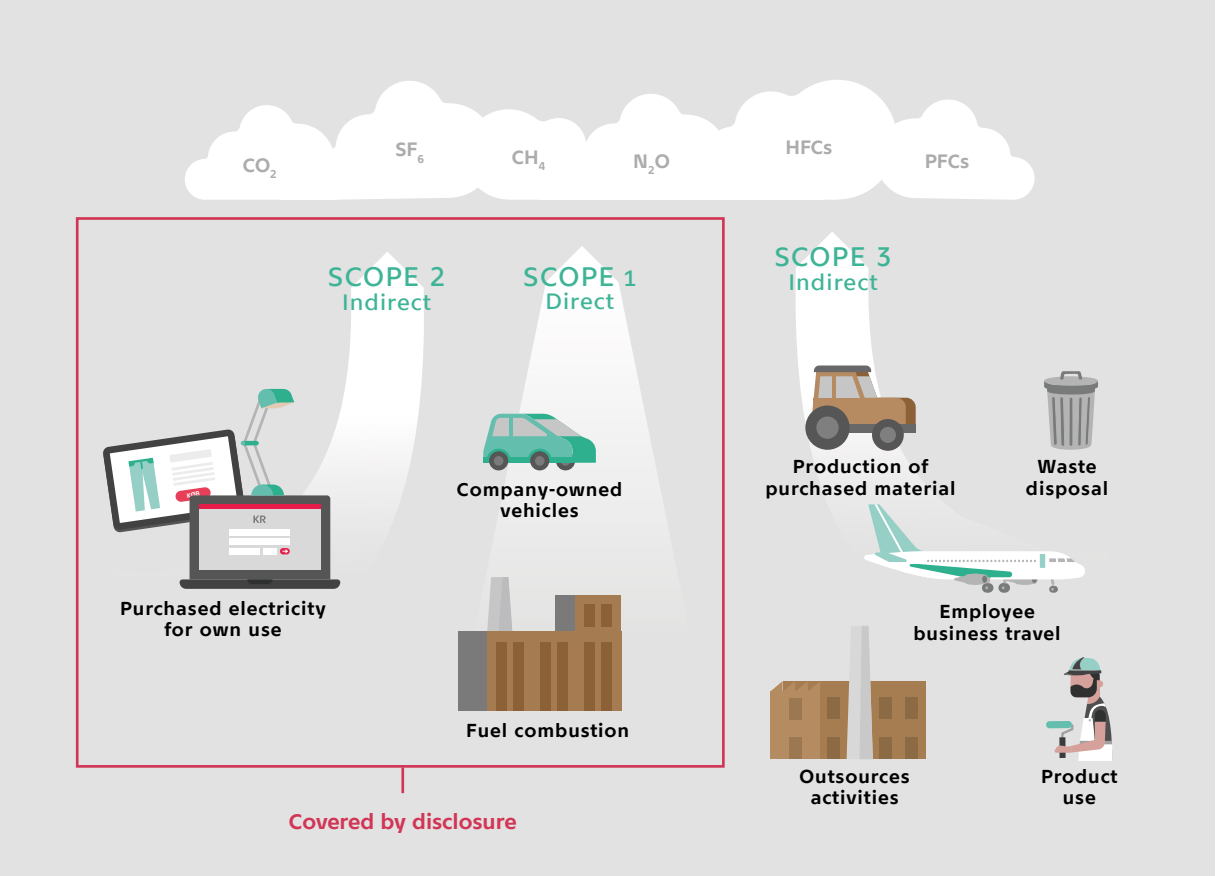
The disclosed climate footprints cover emissions under scopes 1 and 2. This delimitation is illustrated in chart 2. The delimitation is often used in climate-related disclosures, since data for scope 3 emissions at a company level are typically not available with sufficient quality.

Disclosure based on scope 1 and 2 emissions reduces the degree of double counting at the portfolio level. Double counting in connection with scope 3 emissions occurs because one company's

10 A country's consumption-based CO_2e emissions are computed as emissions from production in the home country, plus emissions contained in goods and services imported from abroad and less emissions contained in goods and services exported abroad. Such a computation requires detailed data on international trade flows.

The disclosure from equities and corporate bonds covers companies' direct emissions (scope 1) and emissions associated with purchases of energy (scope 2)

Chart 2



Source: Own illustration inspired by *Greenhouse Gas Protocol: A Corporate Accounting and Reporting Standard*, revised edition, World Resources Institute and World Business Council for Sustainable Development, March 2004.

scope 3 emissions are other companies' scope 1 and 2 emissions. However, there will still be some double counting with scope 1 and 2 emissions, as scope 1 emissions from energy companies will be included in their corporate customers' scope 2 emissions.

Disclosure based on scope 1 and 2 emissions means that any outsourcing of CO_2e emissions is not registered. A company can thus reduce its climate footprint by outsourcing polluting parts of its production and then purchasing the necessary goods and services externally.

Climate footprint of the foreign exchange reserve

Table 1 shows the climate footprint of the foreign exchange reserve for holdings of bonds issued by governments and regional authorities as well as ETFs for each of the three metrics in 2021 and 2022, respectively. The metrics should not be compared across the two asset classes, as CO_2e emissions are allocated differently.

For bonds issued by governments and regional authorities, the average CO_2e intensity was 198 million tonnes of CO_2e per million euro of GDP at the end of December 2022. At the same time, absolute financed emissions amounted to just under 1 million

Climate footprint for Danmarks Nationalbank's foreign exchange reserve Table 1

	Bonds issued by central governments and regional authorities		Equities and corporate bonds (ETFs)	
	2022	**2021**	**2022**	**2021**
Allocation of emissions	Production-based		Scope 1-2	
Weighted average carbon intensity *(tonnes of CO2e per million euro of GDP or revenue)*	198	216	56	106
CO_2e footprint *(tonnes of CO_2e per million euro invested)*	175	248	19	53
Absolute financed emissions *(tonnes of CO_2e)*	965,691	2,107,460	26,806	98,176
Share of market value of foreign exchange reserve in 2022 *(per cent)*	7.9		2.0	

Note: Danmarks Nationalbank's holdings of bonds issued by central governments and regional authorities as well as ETFs are stated as of 30 December 2021 and 30 December 2022. The foreign exchange reserve is stated excluding gold and IMF loans. CO_2e emissions, GDP, revenue, EVIC as well as total bond issuances by central governments and regional authorities for 2021 have been used in 2022, as data for 2022 were not available at the time of disclosure.
Source: UNFCCC, World Bank, Bloomberg, MSCI and own calculations.

tonnes of CO_2e. This resulted in a CO_2e footprint of 175 tonnes per million euro invested. The metrics indicate a lower climate footprint in 2022 than in 2021. The decrease reflects changes in the composition of the portfolio. In addition, the decrease in absolute emissions reflects that the total holding of bonds issued by governments and regional authorities has decreased.

For the ETF portfolio, the average carbon intensity was 56 tonnes of CO_2e per million euro of revenue at the end of December 2022. At the same time, the absolute financed emissions were 26,806 tonnes of CO_2e. This resulted in a CO_2e footprint of 19 tonnes per million euro invested.

In connection with a restructuring of its ETF portfolio in 2022, Danmarks Nationalbank chose to invest exclusively in ETFs that comply with the EU's minimum requirements for *Paris-Aligned Benchmarks* (PAB). The PAB standard requires, among other things, that an ETF's average carbon intensity must maximally be half the carbon intensity of the underlying benchmark index.[11] The conversion of the ETF portfolio to the PAB standard is reflected by a lower climate footprint in 2022 in table 1.

Disclosure of climate footprint is an evolving area

This report has already discussed challenges in the calculation of climate footprint resulting from differences in measurement methods, double counting

11 Emission intensity with reference to the PAB standard is defined as the company's CO_2e emissions (scope 1 and 2) relative to the company's total value (EVIC).

and non-adjustment for general price development. Other factors also complicate the disclosure.

Disclosed climate footprints are based on data compiled for different periods

In the disclosure, Danmarks Nationalbank's financial portfolios have been stated on the last banking day in 2021 and 2022. The other data on which the disclosure is based should ideally also cover 2021 and 2022. However, this is not always possible as the relevant data have not been published at the time of the disclosure. Instead, Danmarks Nationalbank has chosen to use the most recently available data in the disclosure. This means that data for CO_2e emissions, countries' GDP, companies' revenue and EVIC as well as the total bond issuances of governments and regional authorities for 2021 have been used in 2022.[12]

Backward-looking metrics do not capture plans to reduce CO_2e emissions

The disclosure is backward-looking since it is based on countries' and companies' *current* CO_2e emissions. One weakness of backward-looking methods is that they do not consider countries' and companies' plans to reduce emissions in the future.

Despite the fact that backward-looking methods do not consider green transition plans, the methods can nevertheless partially measure financial risks related to climate regulation and transition requirements. A country's or company's current emissions will reflect future risks in connection with transition requirements, as long as, *other things being equal*, countries and companies with large CO_2e emissions have greater difficulties transitioning than countries and companies with lower emissions.

Forward-looking metrics are complex and difficult to implement

In recent years, new forward-looking methods for measuring climate footprints have been developed. Some of these methods, such as scenario analyses, take into account differences in plans and opportunities for reducing CO_2e emissions in the future. However, there is no single forward-looking method that can fully quantify the future transition risks for a country or company. Forward-looking methods are often more complex and sensitive to assumptions used in calculations than backward-looking methods. The Network for Greening the Financial System recommends that central banks be cautious about attaching importance to one single forward-looking metric.[13]

12 The data for companies' CO_2e emissions may potentially cover earlier years than 2021 if more recent data have not been collected by MSCI.

13 See *Guide on climate-related disclosure for central banks*, Network for Greening the Financial System, December 2021 (*link*).

Appendix: Data sources

The appendix provides an overview of the data sources on which the disclosure has been based:

- **GDP for countries:** GDP data come from the World Bank. The data have been stated in purchasing power parity-adjusted (PPP) international US dollars.

- **CO_2e emissions from countries:** The data come from the Secretariat of the United Nations Framework Convention on Climate Change. The data cover emissions within the individual countries' territories. Emissions from land use, land use change and forestry are included in the figures.

- **Total nominal value of bonds issued by governments and regional authorities:** The data come from the data provider Bloomberg L.P. and have been stated nominally at the year-end.

- **Carbon intensity, total emissions and EVIC for companies:** The data come from the data provider MSCI ESG Research LLC. Data for carbon intensity and total emissions cover scope 1 and 2 emissions.

- **Exchange rates and market value of ETFs:** The data come from the data provider Bloomberg L.P. and have been stated at the year-end.

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The report consists of a Danish and an English version. In case of doubt regarding the correctness of the translation the Danish version is considered to be binding.

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